The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

July 1943

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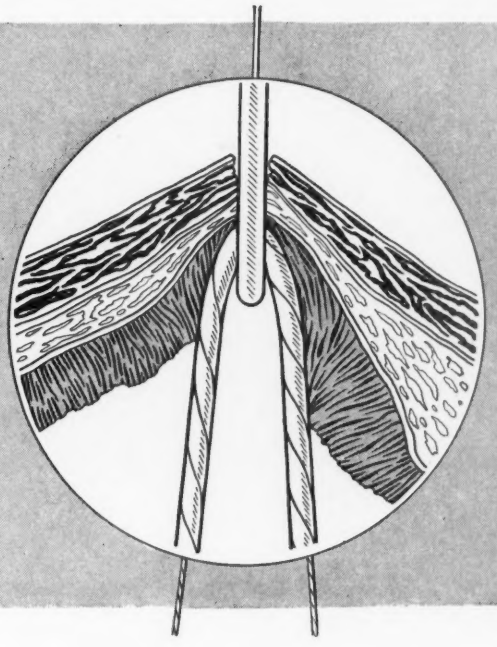

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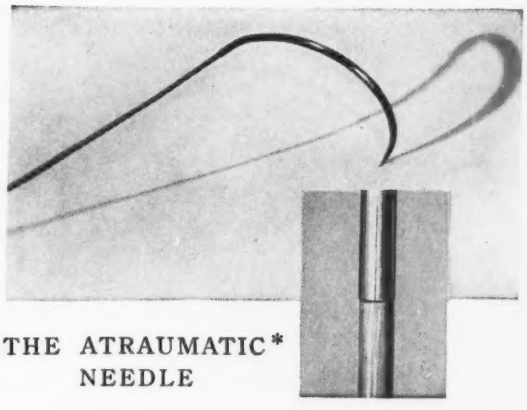

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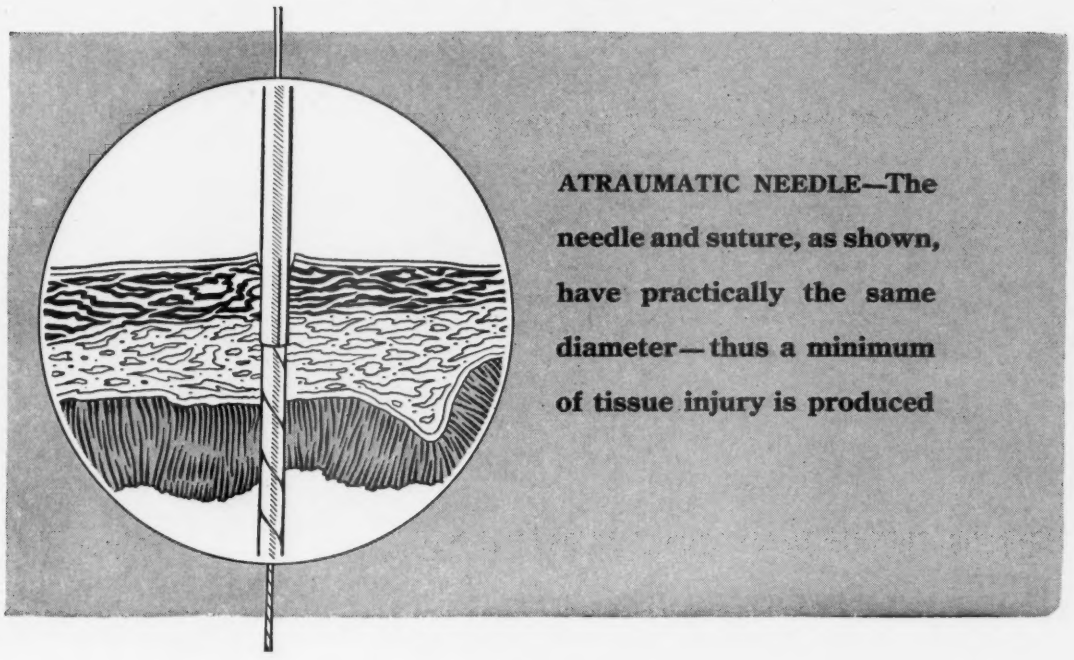

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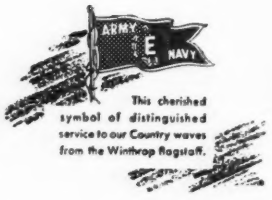

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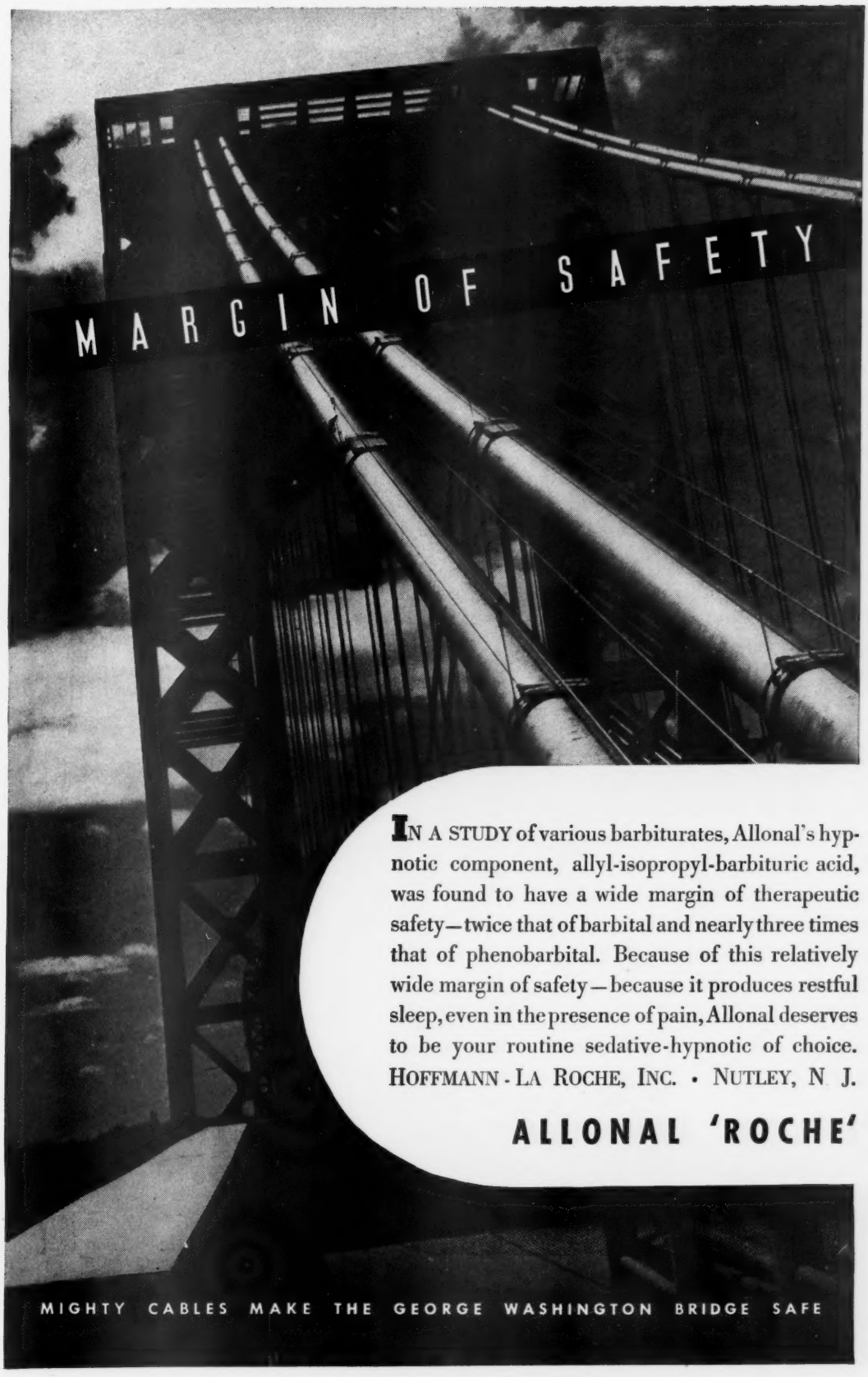

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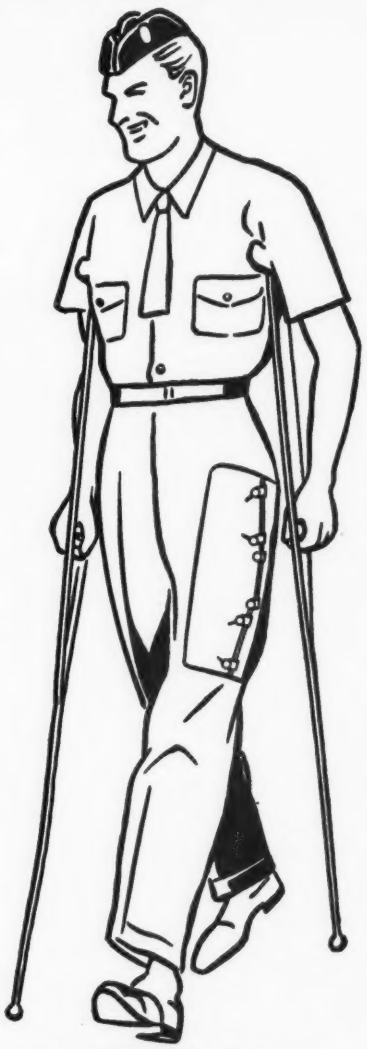

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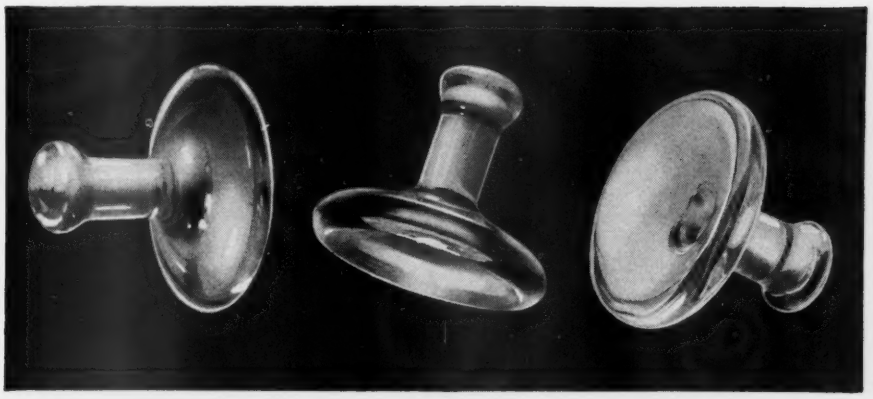

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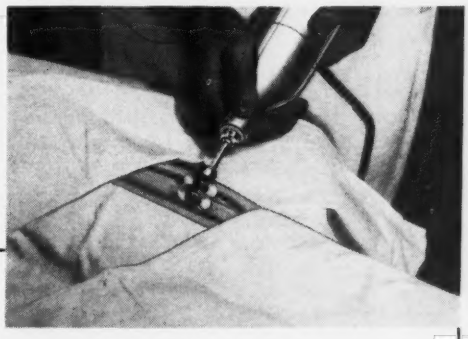

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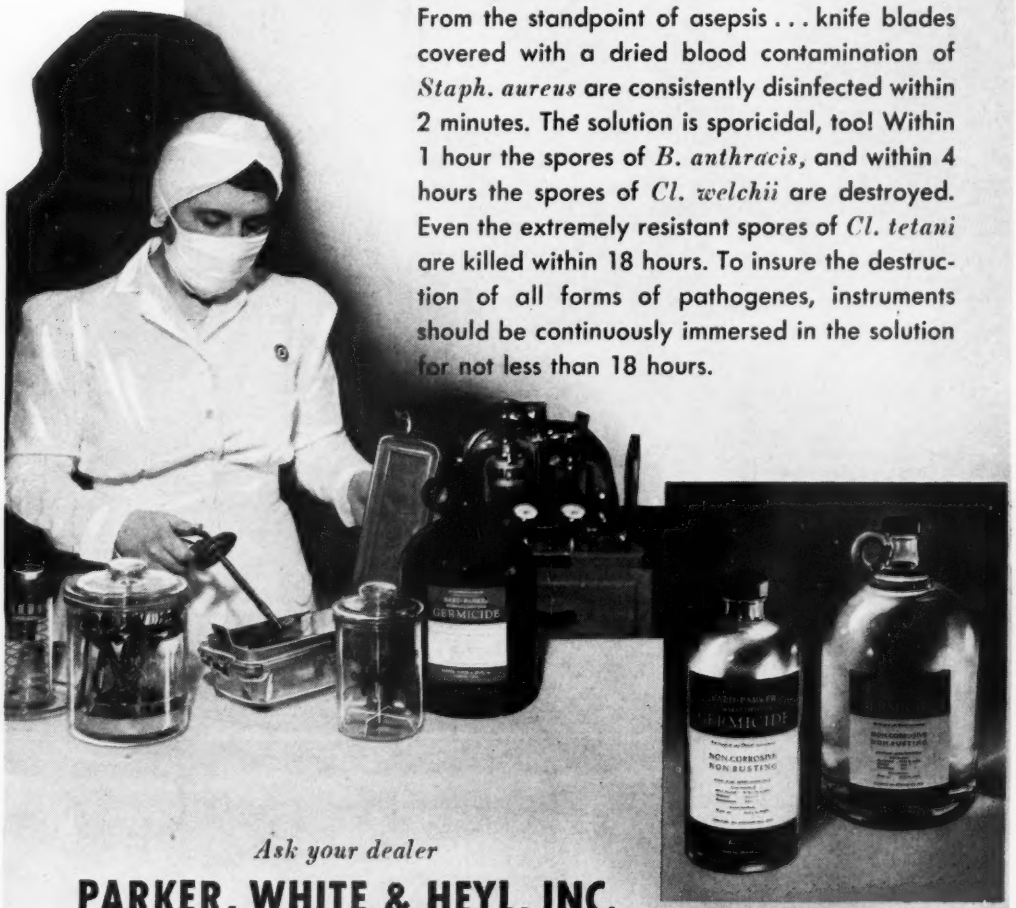

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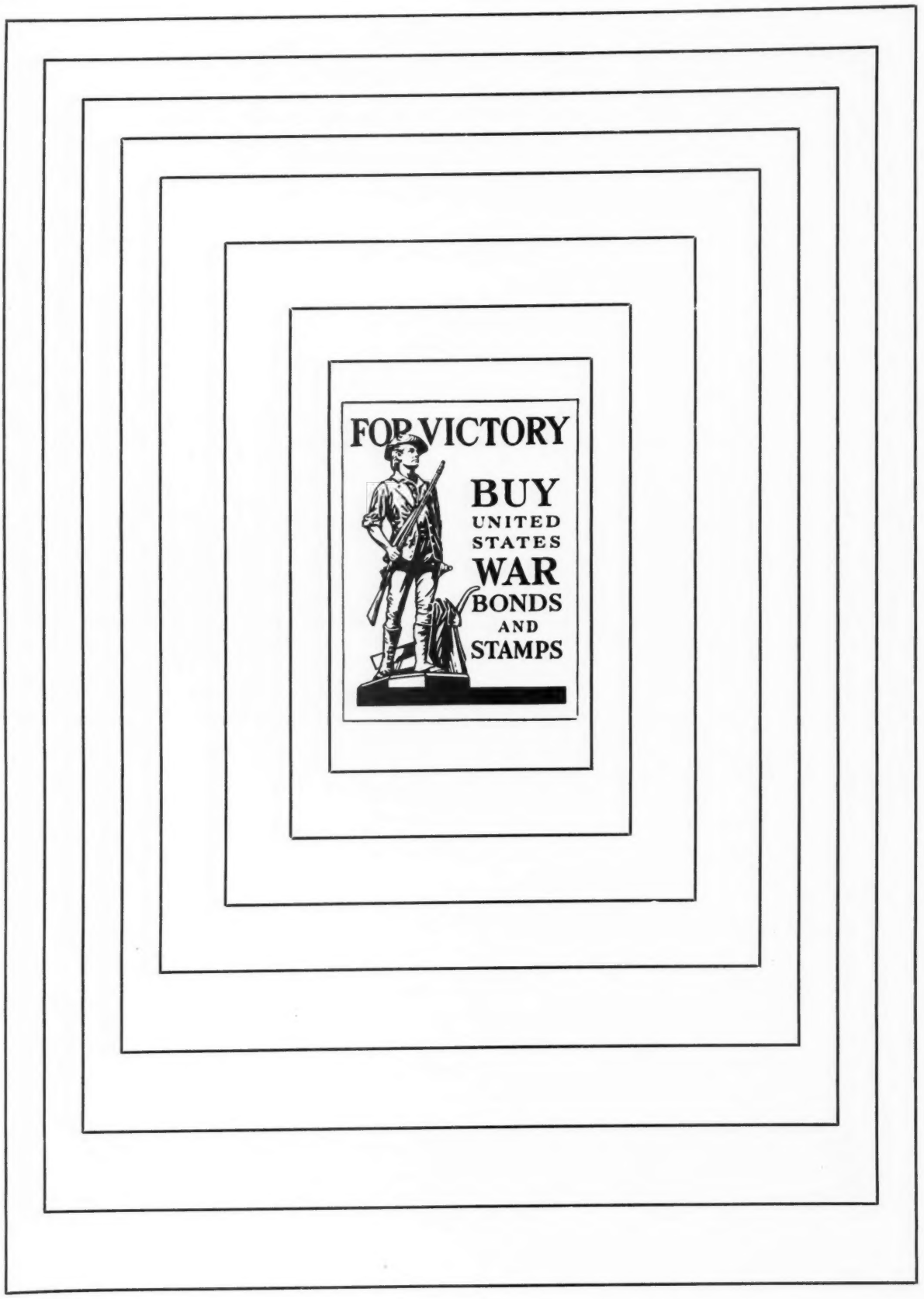
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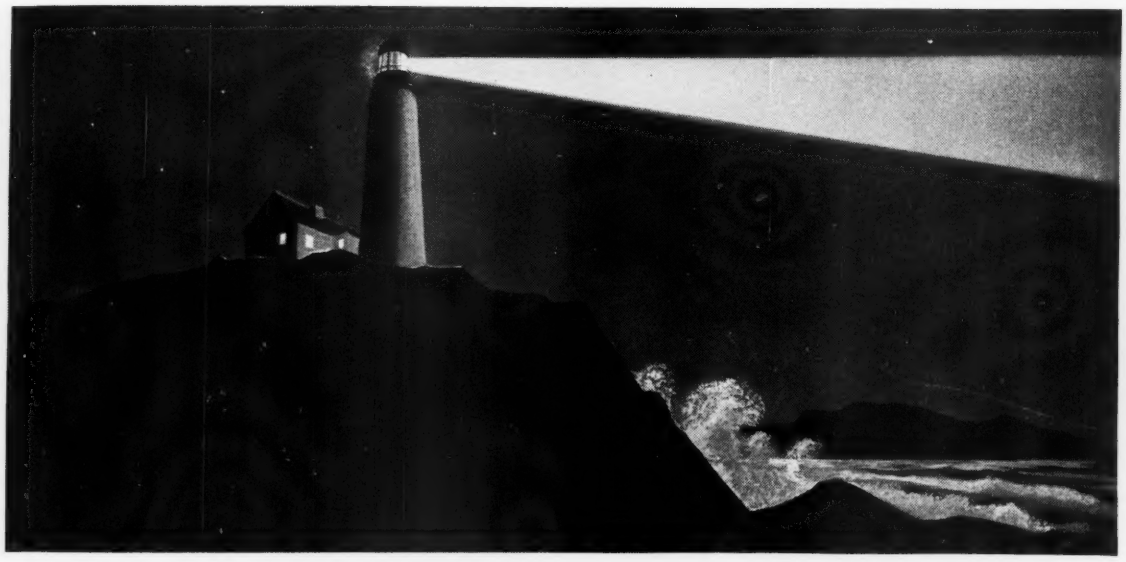

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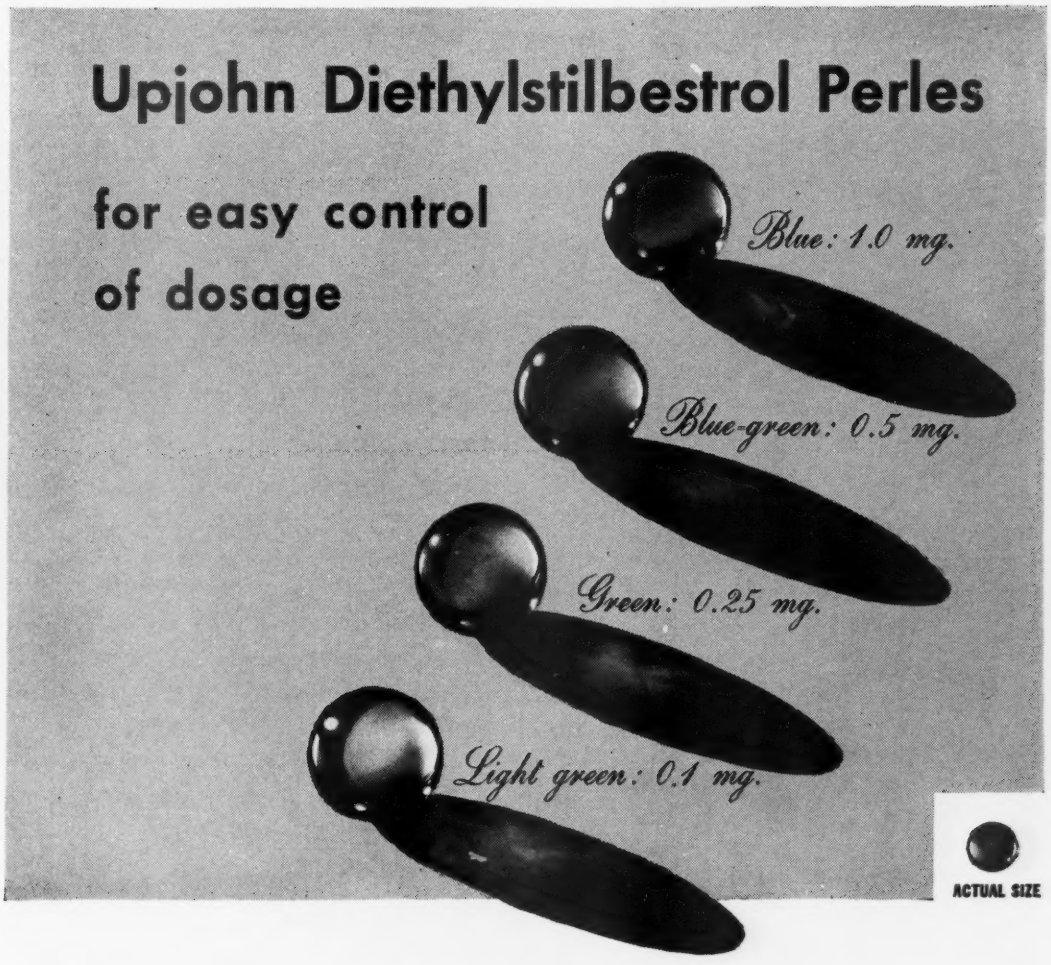

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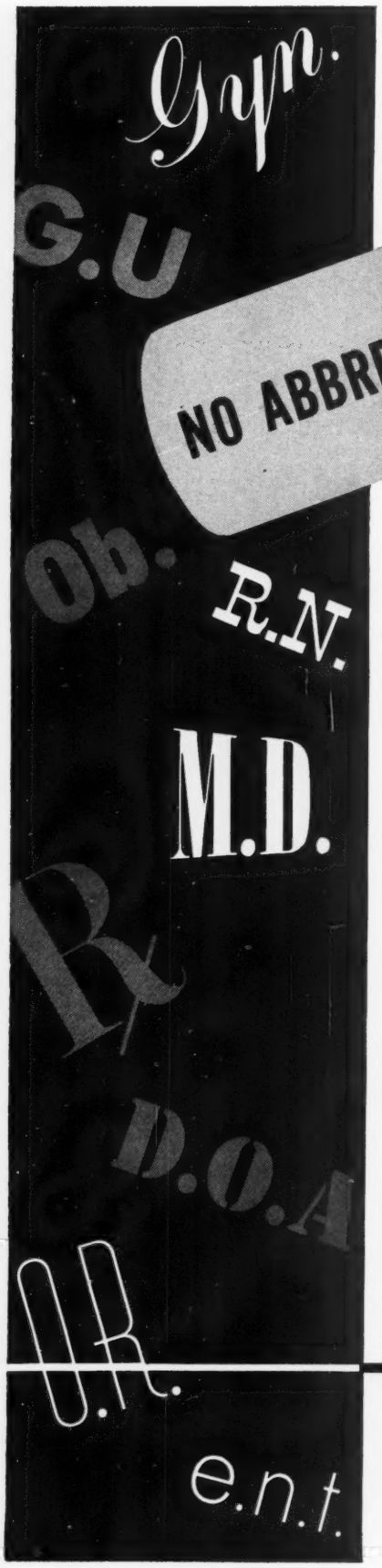

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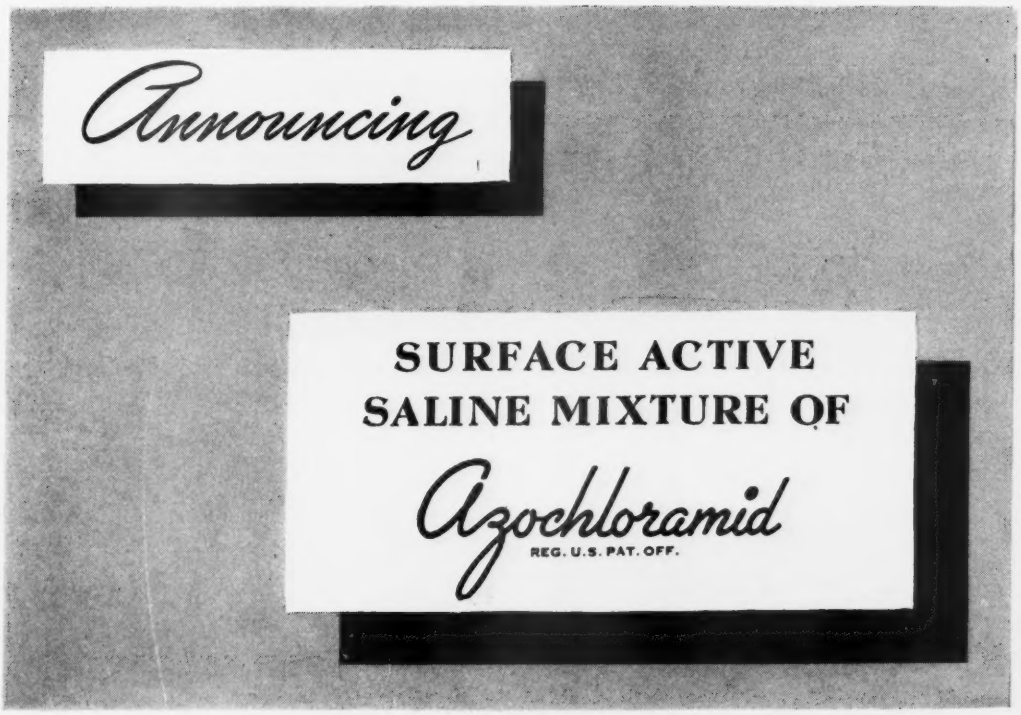

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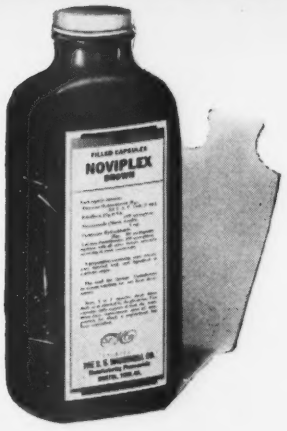

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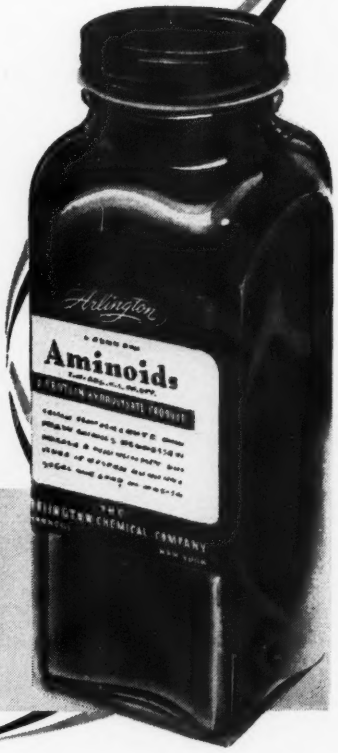

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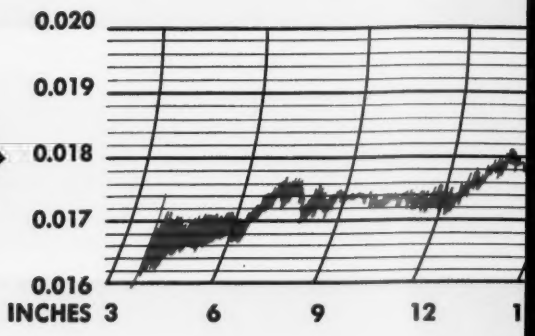

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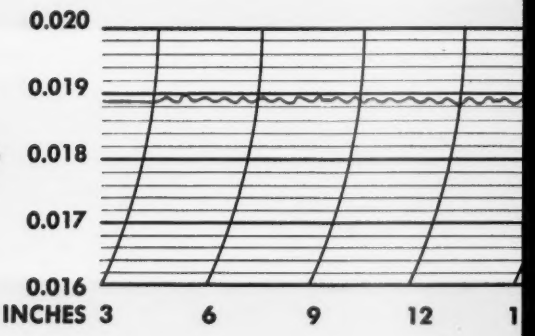

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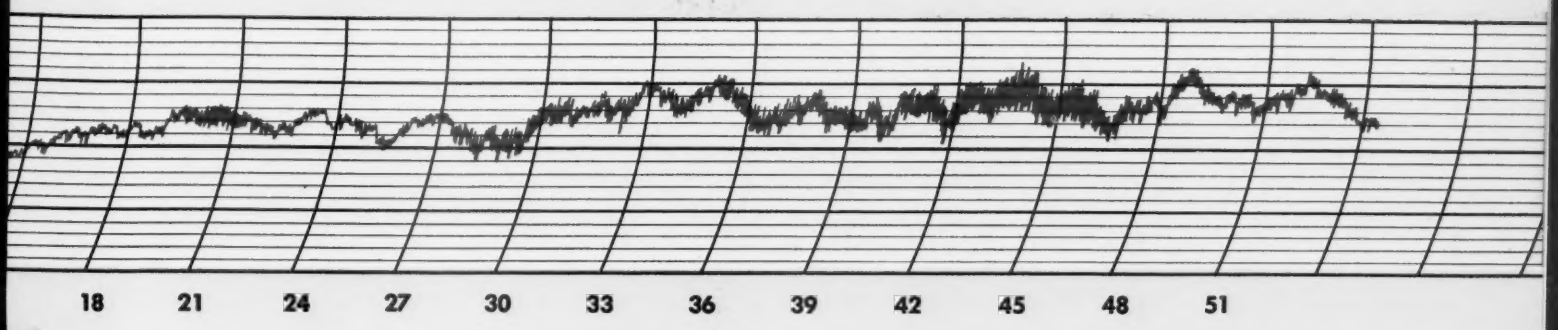

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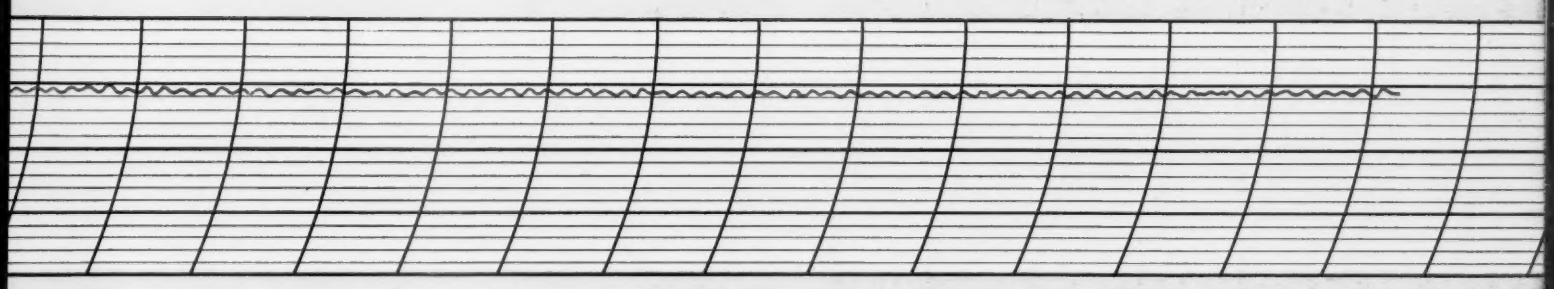

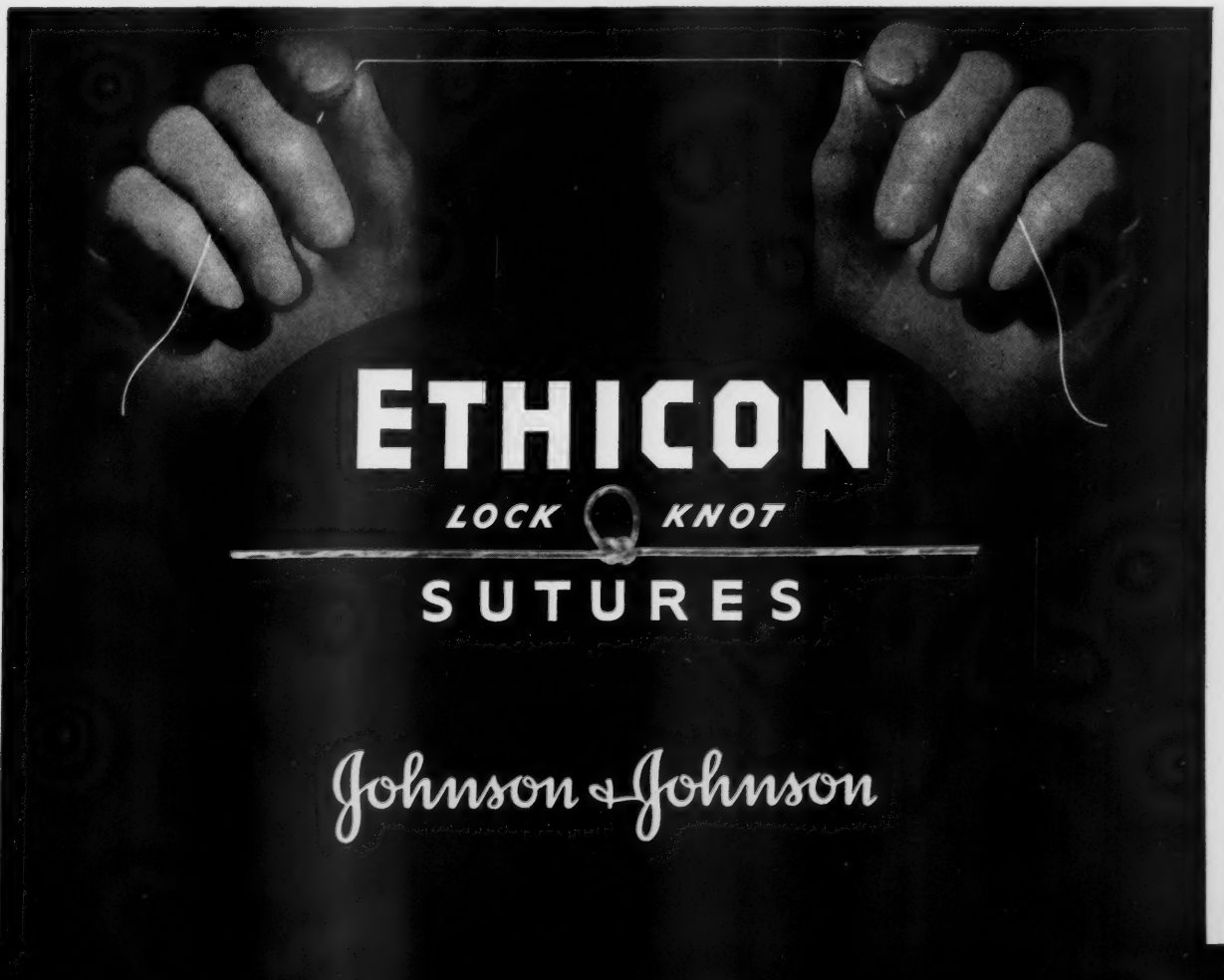

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NEW SERIES VOL. LXI JULY, 1943 NUMBER ONE

Editorials

THE ART OF LOCAL ANESTHESIA

UPON two principles rests the science of surgery—the prevention of sepsis and the use of anesthesia. In the best utilization of both art as well as science is necessary. In the use of a local anesthesia art plays a particular part.

Regional block, infiltration or local anesthesia has many advantages over a general anesthetic. Safety, lowered toxicity and minimal shock follow its judicious employment and with greater experience its field can be broadened to include all types of operation. Yet, except by such masters as Farr and Labatt, its use is not general and in most instances is restricted to minor procedures or for use on moribund patients. This restriction in use is not due to technical errors in its administration, but results from both failure to understand the necessity for gentleness in operating and the importance of the psychic state of the individual patient. Unless one recognizes the importance of these factors in administering local anesthetic, failure will result no matter how skilled the application of the anesthetic. There are certain fundamental points that constantly must be kept in mind. The patient will be awake, apprehensive and aware of all words and actions of the operating team. The comfort and lack of pain of the remainder of the body must be observed. Cramped and uncomfortable positions must be avoided. Pressure from instruments or the assistant's hands must be eliminated. As only the area directly infiltrated will be anesthetized, particular attention must be directed toward gentle handling of tissues. Rough retraction will cause pain beyond the numbed area. Tension on or torsion of organs innervated from beyond the anesthetic zone must be avoided. An entirely different technic, stressing gentleness, smaller and more delicate instruments, needles and sutures and, most important of all, the light hand, must be developed. This régime must be extended from the operator to every assistant or nurse. A general anesthetic frequently creates a false sense of security, even of obtuseness and roughness in the operating room. The fact that the patient is unconscious permits even levity at times and strict discipline frequently relaxes when the difficult technical part of the operation is completed. In the use of a local anesthetic no such situation can endure. Shop talk, rough, though surgical language increases the already high degree of apprehension and the banging and brandishing of instruments may play their part in destroying the co-operation of the patient, on which surgical success depends. Farr attributed a great deal of his outstanding success in performing all types of major operations under a local anesthetic to his "psycho anesthetist," a pleasant faced and voiced individual, who gained the patient's confidence before operation. She

accompanied and remained with the patient in the operating room and prepared him for any untoward reaction before it happened by carefully following the course of the procedure while maintaining her steady flow of conversation. The use of music, in which he pioneered, aided in the distraction. The radio today can play an even better rôle. Entire major procedures can be completed safely without the patient's knowledge with such skilled help. Anesthetists can well add this understanding background to their armamentarium. With local anesthesia this is an asset second only to surgical skill in the successful performance of the operation.

There is no limit to the possibilities of utilizing this anesthetic agent, as every type of surgery has been performed successfully on all parts of the body. In this field, as in many others, the machine trained surgeon who forgets that the "unfortunate victim" is a human being will run into difficulties. To the uninitiated a trial with local anesthesia is recommended. To those who are using it, an extension to other fields is suggested. To the military surgeon its use will not only facilitate the work, but where anesthetists are at a premium, valuable time may be saved. Shock, a major cause of military surgical failure, can be kept minimal by the liberal use of local anesthetic.

To the skilled surgeon adept with local anesthesia many technical aids will be found in the use of this anesthetic agent. For example, deep breathing by the patient at the surgeon's request will lift a deep lying gallbladder neck into the operative field. Voluntary holding of the breath will permit securing of an area difficult to expose. A cough at the command can identify the hernial sac close to the bladder. Dissection of many organs is facilitated by the line of demarkation developed by procaine saline infiltration. In such operations as appendectomy, thyroidectomy, many brain procedures, most rectal work and to a large extent, general abdominal surgery, local anesthesia will be the choice.

Certain technical points are suggested: (1) The aim of the anesthesia is not to hurt the patient. Gain his confidence and maintain it by notifying him beforehand of any new or possibly painful move. Do not have him so inebriated with sedatives that his reasoning power is lost. Have a skilled individual to talk to and guide and distract him during his anesthetic experience. The radio may play a stellar rôle at this stage. (2) Use dilute solutions inserted from one initial wheal. If necessary raise secondary wheals subcutaneously from the first point. (3) Keep the needle moving during the injection to minimize possible intravenous accidents. Guide the needle with the index finger to keep it superficial and in the correct area. (4) Frequently check by aspiration to avoid injecting into a major vessel. (5) Review before the operation the anatomy and especially the nerve supply of the operative area.

Gerald H. Pratt, M.D.

THE FOGGING OF SPECTACLES

IT is axiomatic that the nose as well as the mouth should be covered on all those who enter the operating room. Many wearers of spectacles find hot face masks cause a great deal of inconvenience, because of the readiness with which spectacles became fogged due to the condensation of moisture from expired air. For many years I have used a metallic stiffening in the mask over the nose which has helped tremendously. If it does not cause a dermatitis, adhesive tape as a shield along the top of the mask may be used. To prevent skin irritation, however, I have been wearing a strip of cellulose or scotch tape across the top of my mask which effectively fastens the mask to my face and nose, and prevents any of the expired air from reaching the glasses, thus preventing fog. Continued use of the cellulose tape causes no irritation of the skin. This has been found to be a most satisfactory answer to a very irritating problem.

George C. Foster, M.D.

Original Articles

PERINEPHRIC ABSCESS IN INFANTS AND CHILDREN*

A STUDY OF TWENTY-SIX PATIENTS SURGICALLY TREATED

FIRST LIEUT. HENRY SWAN, M.C., U. S. ARMY
Assistant in Surgery, Harvard Medical School; Resident Surgeon, The Children's Hospital
BOSTON, MASSACHUSETTS

THE recognition that perinephric abscess is not a rare disease in infants and children is important if mistakes in treatment are to be avoided. Failure to consider the lesion as a possibility in diagnosis has occasionally accounted for unnecessary and harmful delay in instituting rational therapy on the part of pediatricians and physicians who are called upon to treat individuals in the younger age groups. Two aspects of the literature impress us as perhaps contributing to this occasional tendency to overlook the possibility of the lesion: first, the paucity of reports dealing with the disease in infants and children; and second, the erroneous conclusion occasionally derived in the study of published series that the disease is quite rare in children. These reports [1–5] are chiefly based on experience with adult patients in clinics engaged in treating older individuals. It is probable that a good many children in the communities in which these studies were made are cared for in hospitals specializing in children, and, thus, cases of perinephric abscess in children are not seen or included in the statistics of the adult institution.

That perinephric abscess is not a rarity in childhood may be seen from the collected series of Schatz[6] and of Greenwald and Kresky;[7] the former finds 174 cases reported in individuals under fifteen years previous to 1927, while the latter finds thirty-three additional cases appearing in the literature from 1927 to 1940. To emphasize this fact it seems worth while to present data on twenty-six proved and six possible cases seen in the last three decades at The Children's and Infants' Hospitals.

ANATOMICAL CONSIDERATIONS

A perinephric abscess is a suppurative inflammatory lesion occurring in the fibrofatty bed surrounding the kidney within the sac formed by Gerota's fascia. An understanding of the anatomy of Gerota's fascia and of the changes in the character of the perinephrium during growth is of paramount clinical importance.

This fascia surrounds the kidney and a considerable amount of its fatty capsule in the form of a loose sheath, in which may be distinguished anterior and posterior walls, the whole forming a sac-like structure roughly the shape of an inverted pear. Laterally, the anterior and posterior walls of the sheath come into contact, fuse, and form a firm lateral wall to the perinephric space. Medially, they remain distinct, and the posterior wall fuses with the fascia covering the psoas and quadratus lumborum muscles, while the anterior wall is continued across the midline in front of the renal vessels and aorta to join the corresponding layer of the opposite side. The vertebral bodies and aorta, however, effectively close the gap medially between the walls and create a barrier to prevent suppuration within one perinephric space from extending to the opposite side. Thus,

* From the Surgical Service of The Children's Hospital and Department of Surgery, Harvard Medical School.

spread of suppuration to the opposite side is virtually impossible and if bilateral perinephric abscesses are found, two different or separate sources must be sought.

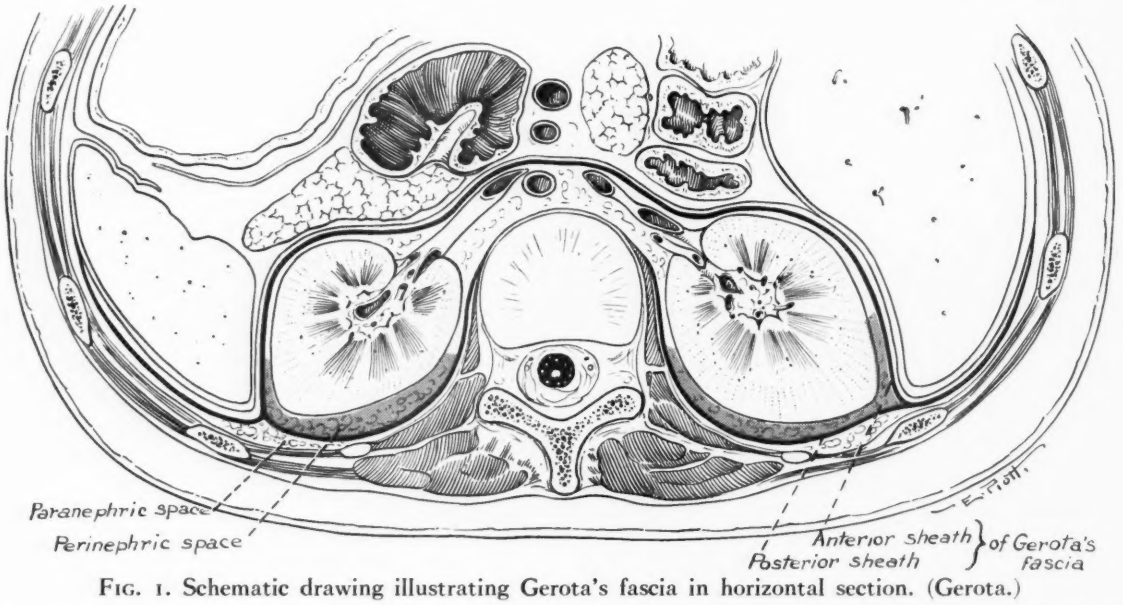

FIG. 1. Schematic drawing illustrating Gerota's fascia in horizontal section. (Gerota.)

Superiorly, above the level of the kidney and the suprarenal gland, the layers of Gerota's fascia unite and fuse with the fascia under the posterior diaphragm. Thus, while upward extension may occur, potentially threatening the subdiaphragmatic spaces, the infection must break through the fascial sheath and the posterior or diaphragmatic peritoneum if subdiaphragmatic abscess is to occur. In our experience,[8] this mechanism has never been the cause of a subdiaphragmatic space infection in children. (Fig. 1.)

Inferiorly, the layers are separately prolongated forming a tunnel-like extension of fascia downward around the ureter, ultimately to fuse with the lumbosacral fascial planes in the pelvis. There thus exists a natural path toward the pelvis for extension of perinephric inflammation, an event of frequent occurrence. This anatomical arrangement has been demonstrated radiographically by Rolnick,[9] and aids us to understand why pelvic extension of infection may commonly occur (thus causing certain radiographic phenomena), why signs of irritation of the psoas muscle are frequently observed ("psoas spasm"), and why signs suggesting retrocecal appendicitis may occur (deep tenderness in the right lower quadrant, with or without a positive "psoas sign," in a patient with the constitutional signs of infection). Anatomically, the rectrocecal abscess is anterior and lateral to the peri-ureteral extensions of Gerota's fascia, but because of the similarity in signs clinical distinction is often quite difficult. The term *paranephric* space has been used to describe this region in the lumbar gutter which is *outside* of Gerota's fascia.

In the newborn infant, the perinephric fat is sparse, and the space inside the sac formed by Gerota's fascia is relatively small. The increase in fibrous adipose tissue occurs, leaving the kidney encased in a thick sheath of fat. Thus, in a young child the perinephrium is relatively emptier than in an adult. This fact has been offered as an explanation of the alleged rarity of the lesion in children. This could be so only in those lesions in which infection is presumed to be seeded directly into the perinephrium from a distant focus. Obviously, the amount of perinephric fat can have little bearing on the incidence of infections seeded first in the kidney and then breaking into the space from the kidney, as this

would occur whether the surrounding fat were sparse or abundant. It is our belief that this latter is the usual if not invariable sequence.

INCIDENCE

All of our patients were under thirteen years of age. As can be seen in Figure 2, the distribution by age was relatively uniform throughout this period of life. This was true whether the lesion was metastatic or complicated underlying renal pathology. Our youngest patient was four months of age. (Fig. 2.)

In children, the difference in sex incidence does not appear to be quite as marked as is apparently true in adults in which males predominate in a ratio of about 3 to 1.[1] In our series, sixteen were males and ten were females, a ratio of about 3 to 2. The side involved seems to be of no significance, as thirteen of our patients had right lesions, and an equal number had left lesions. This was true whether the disease was metastatic in origin or whether it complicated underlying renal disorders.

CLASSIFICATION

Infection of the perinephrium is always a lesion secondary to infection elsewhere in the body, whether metastatic via the blood stream or lymphatics, extension direct or indirect from adjacent structures, or rupture into the space from the kidney. Infection, however, may reach the perinephrium by means of a blood-seeded abscess in a previously normal kidney which then breaks into the perinephric space and, indeed, most authors consider this as the usual if not invariable sequence of events. Such an abscess is in a sense "renal" in origin, but the clinical implications and significance of such a lesion is clearly not the same as an abscess arising from a kidney which is itself the seat of a pyonephrosis or pyelonephritis. In this discussion, therefore, we shall classify those perinephric abscesses which are secondary to a distant focus as "metastatic" whether or not a cortical abscess of the kidney is known to be present. Those perinephric abscesses secondary to underlying (chronic) renal disease we shall designate as "complicated." A third group is secondary to trauma to the kidney, with hematoma formation which subsequently becomes infected. Table I is a classification of the cases to be discussed in this paper.

Table I

Classification of cases of perinephric abscess

I. *Metastatic*	11
II. *Complicated*	
1. Pyonephrosis	7
2. Chronic nephritis	1
3. Tuberculosis of kidney	1
4. Actinomycosis of kidney	1
5. Postoperative ureterosigmoidostomy	4
III. *Post-traumatic*	1

BACTERIOLOGY

The organism most frequently found in metastatic perinephric abscess is the staphylococcus; indeed, the recovery of that organism suggests a metastatic pathogenesis. In the other types, a wide variety of infectious agents are found. One of our patients had an infection of the perinephrium secondary to renal tuberculosis, while another was secondary to antinomycosis. Both of these patients died. Apart from these two organisms the bacterial agent appears to have no prognostic significance. Table II lists the infecting organisms found in our series of patients.

Table II

Bacteria recovered from twenty-six perinephric abscesses

I. *Metastatic*	
1. Staphylococcus aureus	7
2. Staphylococcus albus	1
3. Beta hemolytic streptococcus	1
4. Streptococcus fecalis and Bacillus coli	1
5. Unknown	1
II. *Complicated*	
1. Staphylococcus aureus	2
2. Bacillus coli	2
3. Streptococcus fecalis and Bacillus coli	1
4. Bacillus pyocyaneus	1
5. Tubercle bacillus	1
6. Actinomycosis	1
7. Gram-positive cocci	1
8. Unknown	2
III. *Post-traumatic*	
1. Staphylococcus aureus	1
2. Streptococcus fecalis and Bacillus coli	1
3. Gram-positive cocci	1
4. Unknown	1

CLINICAL ASPECTS

The symptomatology of perinephric abscess as observed in children differs little, if any, from that seen in adults, and thus deserves but passing comment in this paper. There are three factors of clinical importance, however, which appear to us to merit emphasis:

In the first place, we have found that the site of the pain in children may be quite varied, and frequently fails to suggest the perinephrium as the site of disease. Thus many of our patients complained of pain in the peri-umbilical region, others in the hip, and others in the back. Some did, indeed, have definite flank pain. On examination, however, the signs will be found chiefly in the flank and costovertebral angle where there is almost always tenderness, usually spasm, and occasionally a mass visible or palpable. Occasionally, a visible bulge may be seen extending forward into the upper quadrant of the abdomen, and the underlying palpable mass may be felt abdominally, continuing backward into the flank. In one case a *separate* discreet mass could be felt anteriorly which was thought to be the spleen displaced forward by the underlying perinephric abscess. The important point to remember, however, is that although the pain may be referred to the abdomen, hip, or back, the disease may lie in the lumbar gutter, and the alert physician will carefully include that region in his examination.

Secondly, the *type* of abscess whether metastatic, complicated or traumatic may usually be diagnosed from the history. The history of the presence of *antecedent infection*, such as furuncles, otitis media or respiratory infection suggests the metastatic type, but it is surprising how frequently the history in children is lacking in details on this point, the parents having overlooked the initiating lesion because the children made no complaint at the time. A searching attempt, however, should be made in obtaining the history to establish evidence on this point.

FIG. 2. Age incidence in twenty-six cases of perinephric abscess.

Of much more aid in diagnosing the type of perinephric abscess is the presence or absence of *urinary complaints*. In the metastatic lesions, the onset is usually relatively abrupt, the patient becoming ill in a matter of a few hours or days. Pain and fever are universal symptoms. There may be chills, malaise, anorexia, scoliosis or limp. But urinary complaints such as dysuria, frequency, nocturia or pyuria are quite rare. In contrast, the lesions of the complicated variety associated with underlying renal disorders usually present quite a different symptomatology. The onset is insidious; there is a long history of frequency and pyuria, and occasionally dysuria; the patient has usually lost some weight and has run a low grade fever for some time; and finally pain, increased fever, limp or scoliosis is added to the picture. If, therefore, the history includes urinary complaints and a diagnosis of

perinephric abscess is made, a lesion complicating underlying renal disturbance should be suspected and a careful study of the entire urinary tract should be made.

Lastly, the frequency with which "limp" is the admitting complaint in children is noteworthy. This is due to the irritation of the psoas muscle by the overlying inflammatory process. There is limitation in extension at the hip (psoas spasm) and the patient lies with the ipsilateral knee in flexion. Other motions of the hip are normal. This situation may lead to an erroneous impression of hip-joint disease. Indeed, in one of our cases, the patient had been previously placed in leg traction for a short time before the true nature of the disease was recognized. In all children, therefore, who have a complaint of "limp" when first seen and who have in addition the constitutional symptoms of an infectious disease, perinephric abscess must be remembered and seriously considered in the differential diagnosis.

LABORATORY DATA

The urinalysis of patients suspected of having perinephric abscess appears to be of considerable clinical importance, particularly in distinguishing the simple metastatic type from those complicating underlying renal disorders. Table III presents in some detail the urinary findings in our series of patients, both on admission and subsequent thereto. The difference between the first group (metastatic) and the second group (complicated) is quite striking.

In the first place, there was a marked difference in the appearance of albumin in the urine. In patients with a metastatic type of abscess, no albumin was present in the urine of any of our patients, except one. This patient, however, on all subsequent examinations also had negative tests for albumin. In contrast, those patients with abscesses complicating underlying renal disease almost uniformly showed positive tests for albumin; only two failed to have any albumin, and most of the remainder had strongly positive reactions.

In a similar way, examination of the urinary sediment gives valuable information in differentiating between the two groups. In the metastatic variety, no white blood cells were present except in three patients, and in these they were described as "rare" or "occasional"; and two of these patients were entirely cell-free on subsequent examination. In contrast, all but one of the patients with a complicated type of lesion had white blood cells in the sediment, and most of these were described as "many" or "loaded." These examinations, it should be mentioned, were done on the uncentrifuged specimen. (Table III.)

We believe that Table III effectively demonstrates the marked clinical importance of urinalysis in perinephric abscess in children, and the close correlation between the urinary findings and the type of abscess present. If this be interpreted with the history, we believe that an accurate preoperative diagnosis of the type of lesion, whether metastatic or complicated, can and should be made in children. This is of paramount importance, as the prognostic implications and therapeutic indications are quite different.

Other laboratory findings are of only passing interest. All of our patients had a moderate to advanced leukocytosis, the levels varying between 13,000 and 50,000 white cells per cubic millimeter. Associated with this was an increase in the proportion of polymorphonuclear leukocytes, with occasional values as high as 95 per cent. Blood cultures were taken only infrequently in our series, but were found to be positive for Staphylococcus aureus in two patients in the metastatic group. We believe that important information may be derived by this determination and intend to study this more extensively in subsequent patients.

TREATMENTS AND RESULTS

Intravenous pyelography, we believe, should be included in the preoperative study of *every patient* suspected of having perinephric abscess unless the patient is so

desperately ill that the procedure is contraindicated. This will give confirmatory roentgenographic evidence in establishing the diagnosis, will demonstrate underlying renal abnormalities in those patients with the complicated type of lesion, and also will establish the presence and gross functional status of the contralateral kidney. Thus, the procedure is of marked diagnostic and prognostic value, and will indicate further diagnostic and therapeutic steps.

The treatment varies with the type of abscess. In the metastatic variety, as soon as the diagnosis is reasonably established, incision and drainage is carried out. Occasionally, a patient is seen with a story and physical findings suggesting infection in the perinephrium, but in whom the constitutional reaction is not marked. Following rest in bed and application of local heat, the symptoms and signs gradually regress and the patient entirely recovers. We have had six patients (not included in the present series) whose history and physical findings when first seen suggested perinephric abscess, but who, under conservative therapy and observation, recovered completely without surgical treatment. It is our belief,

TABLE III

URINALYSIS IN TWENTY-SIX CASES OF PERINEPHRIC ABSCESS

	Admission				Subsequent†			
	Albumin	White Cells	Red Cells	Culture*	Albumin	White Cells	Red Cells	Cultures
I. *Metastatic*								
Case 1	o	rare	o	+	o	o	o	+
2	o	o	o	o	o	o	o	o
3	o	o	o	o	o	o	o	o
4	o	o	o	−	o	o	o	−
5	+	o	o	−	o	o	o	−
6	o	o	o	−	o	o	o	−
7	o	rare	o	+	o	o	o	+
8	o	o	o	o	o	o	o	−
9	o	occas.	o	−	o	5–15	o	−
10	o	o	o	o	o	o	o	−
11	o	o	o	o	o	occas.	o	−
II. *Complicated*								
Case 1	++	many	o	−	++	loaded	o	−
2	+++	loaded	o	+	++	loaded	o	+
3	++	loaded	o	o	++	loaded	o	o
4	++++	occas.	o (casts)	−	o−++	occas.	o (casts)	o
5	o	8–10	o	o	+	loaded	o	+
6	+++	loaded	o	−	+++	loaded	o	−
7	o	o	o	+	o	o	o	−
8	+	many	o	−	++++	many	o	−
9	++++	loaded	o	o	++++	loaded	o	−
10	+++	loaded	o	o	o−++	loaded	o	o
11	+++	occas.	occas.	+	o−++	loaded	occas.	+
III. *Traumatic*								
Case 1	o	o	o	−	o	o	o	−
2	o	o	3–5	−	o	loaded	rare	+
3	o	o	o	−	o	o	o	−
4	+	o	o	−	o	occas.	o	−

* Culture symbols: + = positive; o = negative; − = not done.

† A urinary examination was chosen which as nearly as possible was representative of the urine during the patient's subsequent hospital stay.

though of course in these cases the diagnosis was not established, that these patients probably represent cases in whom cortical abscesses were present with perhaps some inflammation of the perinephrium, but in whom the body defenses overcame the infection and no softening or abscess formation occurred. It would be unwise to incise and drain these individuals. However, once the signs and progress of the disease indicate that suppuration has occurred, further delay will merely prolong the hospital stay. It is our belief, therefore, that drainage should be performed as soon as the diagnosis of abscess is reasonably established. The abscess should be adequately opened and gently explored with the finger. Extensive exploration for the kidney which breaks down inflammatory barriers must be avoided. Drains are inserted, and the wound closed loosely to the drains.

In our group of eleven metastatic perinephric abscesses, the average duration of the history was two weeks; the average delay preoperatively in the hospital was four days, the extremes being one day and twelve days; and the average postoperative hospital stay was twenty days. There was no mortality in this group.

The treatment and prognosis of the complicated variety is entirely different and must be individualized. The therapy is really two-fold: the immediate treatment of the perinephric abscess, and the subsequent treatment of the underlying urinary tract lesion. Intravenous pyelography can usually be done preoperatively. Whether cytoscopy and retrograde studies can be made also will depend upon the condition of the patient. When possible, it is advisable to do so in order to obtain as thorough information as possible on the status of the entire urinary tract, particularly the function of the contralateral kidney. The need for this is emphasized if at the time of operation or subsequently, nephrectomy seems indicated. Limitation of the operation to incision and drainage at the first operation is thought to be the treatment of choice. However, in two of our patients, the amount of disease of the kidney found at operation was so great that the operator decided to do a nephrectomy during the primary procedure. Both of these patients subsequently did well. In four patients, incision and drainage were performed once or more often but persistence of marked local infection led secondarily to nephrectomy. Of these patients, three died. One had antinomycosis, another had tuberculosis, while the third had congenital megaloureter. It would seem, therefore, that in children, if adequate kidney function and freedom from infection is demonstrated to exist on the contralateral side, and if the diseased kidney is shown at operation and by pyelographic studies to be seriously and irreversibly involved, primary nephrectomy may well be the procedure of choice in selected cases.

If it is thought that the kidney can be saved, simple incision and drainage is advised to overcome the perinephric infection. After the wound has healed, further studies leading to procedures to remedy the underlying lesion (for example, ureteropelvotomy for ureteropelvic stricture, or excision of posterior urethral valves) are carried out as soon as possible.

The term of hospitalization and the mortality of complicated perinephric abscess have been forbidding. The total hospital stay of the patients in this group averaged seventy days. The mortality was 45 per cent, five of the eleven patients succumbing sooner or later to their underlying lesion.

The prognosis and treatment of posttraumatic abscess is similar to that of metastatic abscess. Early drainage is usually all that is needed. In one of our patients, however, the kidney was so badly traumatized and involved in the secondary infection that primary nephrectomy was performed. The mortality in this group was zero.

We have not had sufficient experience in this disease with sulfonamide therapy to evaluate its worth. In the metastatic type

of lesion, due most frequently to Staphylococcus aureus, duration of the illness seems unaffected by the use of sulfadiazine. In the complicated type, the sulfonamides are useful in combatting the urinary infection due to Bacillus coli, but have seemed to have but little effect on the course of the inflammatory process in the perinephrium. Both the oral administration and the use of powdered drugs locally merit further study and evaluation.

SUMMARY

1. Perinephric abscess is not as rare a disease in infants and children as has been believed. A series of twenty-six proved and six possible cases is presented.

2. To classify patients on the etiologic basis of their lesion as metastatic, complicated by underlying renal disease, or secondary to trauma to the kidney, is important for prognostic and therapeutic reasons.

3. In children, a history which includes urinary complaints or a finding of albumin or white cells in the urine strongly suggests a complicated type of lesion, and indicates a thorough study of the urinary tract.

4. An intravenous pyelogram should be done preoperatively on all patients suspected of having perinephric abscess, unless they are too ill to tolerate the procedure.

5. For metastatic, or traumatic abscess, early incision and drainage is the treatment of choice.

6. In abscess complicating urinary disease, therapy must be individualized and is two-fold in purpose: first, the immediate treatment of the abscess, and second, the subsequent treatment of the underlying urinary tract disease.

7. In metastatic or traumatic abscess in children, the mortality was nil and the hospitalization averaged about three weeks.

8. In abscess complicating urinary disease in children, the mortality was 45 per cent and the hospital stay averaged about ten weeks.

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PRESENT STATUS OF GASTRIC AND DUODENAL ULCER*

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BUSINESS men make inventories. We physicians and surgeons write reviews. In both phases of endeavor, the purpose is essentially the same, i.e., to take stock, to determine progress, to learn what is missing and what is needed. This, in general, is my purpose in presenting a brief report on the present status of gastric and duodenal ulcer.

In considering this subject, I realize that we are somewhat hampered by lack of knowledge concerning the etiology of these lesions. Of course, many theories have been advanced and much evidence to support each view has been presented, but their very multiplicity is most indicative of inadequate basic information. In his review of the pathogenesis of peptic ulcer, Held[1] listed the six most probable causal theories as follows: vascular, neurogenic, acidity, catarrhal, focal infection and constitutional.

Some workers lean to the view that gastroduodenal ulcers are largely of psychogenic origin, being intimately associated with such factors as temperament, environment and economic status. More recent studies, however, have re-emphasized the importance of the acid gastric secretion in the production of such ulcers. According to Palmer,[2] the ulcer problem is one of tissue resistance versus acid attack While not implying that excessive secretion or retention of gastric juice in the stomach is the cause of gastroduodenal ulcer, Schiffrin and Ivy[3] are of the opinion that destruction of gastric tissue results from the proteolytic action of the gastric juices. Dragstedt[4] suggests that in most cases hypersecretion of gastric juices is probably neurogenic, this secretion being abnormal in that it occurs when the stomach is empty and in the absence of the usual gastric secretion stimuli.

It seems to me that no single factor is responsible for the appearance of gastroduodenal ulcers, but rather that a combination of local, systemic and psychogenic factors act together in producing the localized lesions.

There is a growing tendency, in discussing the symptomatology, diagnosis and management of peptic ulcers, to make definite distinctions between gastric ulcers and duodenal ulcers. To me, this is a sign of progress in a poorly understood physiological derangement, for it shows that despite gaps in our knowledge of these lesions we have learned much that is of value to ourselves and our patients.

Pain, weight losses, vomiting and tarry stools are typical symptoms of gastric ulcer, but even these are variable. The duration of symptoms, while sometimes helpful in making a diagnosis, is not dependable. A correct diagnosis must depend upon the correlation of data obtained from the clinical history, the symptomatology, gastric analysis, *x*-ray examination and, where indicated, gastroscopy. It is only by such means that we can determine whether medical treatment should be given a trial or whether immediate surgical intervention may be indicated.

Careful correlation of such information is a prime factor in differentiating between benign and malignant gastric lesions. Such differentiation, at best, is difficult and we must call upon every diagnostic aid at our disposal to substantiate the correctness of our findings.

This fact has been strongly stressed by Walters,[5] who pointed out that attempts at medical treatment of lesions that are diagnosed as benign, but which are actually malignant, may delay necessary surgical

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intervention until the lesion becomes inoperable.

"It is apparent, therefore," said Walters, "that one of our problems as diagnosticians and surgeons lies in trying to determine the pathologic nature of the lesion from the patient's history and physical examination and the reports of the roentgenologist and the gastroscopist. In many cases this is exceedingly difficult. Although the expert roentgenologist may recognize the presence of a gastric lesion in 98 per cent of cases in which it is present, he has emphasized repeatedly that there is a definite percentage of error in distinguishing a nonmalignant from a malignant gastric ulcer. This has too frequently been forgotten."

The gastroscope has become a patent aid in this differential diagnosis. Indeed, some workers (Schindler and Arndal[6]) are of the opinion that gastroscopy is more informative than roentgenoscopy. However, the general consensus of opinion, and one in which I fully concur, is that gastroscopic examination is an important supplementary aid to the *x*-ray (Clerf and Wirts,[7] Segal[8]). The limitations of the gastroscope should be recognized; but when the findings with this instrument are correlated with the roentgenological picture, we have the means for materially lowering the percentage of diagnostic error in differentiating between gastric ulcer and gastric carcinoma. Nor should we overlook the value of the gastroscope as a means of checking the progress of questionable gastric lesions undergoing medical treatment.

Duodenal ulcer is much more common than gastric ulcer. As Allen[9] recently stressed, this fact has led us to make generalizations which, while sound as far as duodenal ulcer is concerned, are now questionable as regards gastric ulcer. The importance of differentiating these two conditions lies in the fact that duodenal ulcers are much more amenable to medical treatment than are gastric ulcers. In the Massachusetts General Hospital, for example, it has been found that about 80 per cent of the cases of duodenal ulcer can be successfully treated by the medical service (Allen,[9] Allen and Welch[10]). Vale[11] has estimated that over 85 per cent of cases of duodenal ulcers can be effectively treated by medical means alone. Except in cases of acute perforation, cicatrization or instances of severe and prolonged hemorrhage, surgical intervention does not appear indicated until after adequate medical management has failed.

No matter what the condition being treated, we at the DeCourcy Clinic have always emphasized the importance of considering each patient as an individual. Nowhere is this more important than in the treatment of patients with gastric or duodenal ulcers. Attempts at standardization with these cases can only result in disappointment and, very often, in failure. This, of course, implies that whatever treatment is undertaken will be determined not only by the physical condition of the patient but also on the basis of his personality, environment and economic status. This is especially pertinent in the nonsurgical procedures, but it holds quite as strongly in the postoperative and follow-up periods after surgical intervention.

It is only after such careful consideration of all the facts and findings that the decision can be made as to whether medical or surgical treatment is indicated. Obviously, medical treatment is preferable and should be used where the indications permit. However, in certain instances, the nature or location of the ulcer makes surgical intervention a necessary step from the very start.

From a consideration of the recent literature, it would appear that the medical treatment of gastroduodenal ulcer is in a state of flux—a transition from older procedures toward newer methods based upon wider knowledge. There is an apparent tendency to depend less upon antacid treatment with alkalis and to resort more and more to frequent feeding schedules. In this connection, it is significant that Vale[11] lists the four local conditions which the internist attacks by more or less direct

means in the following order: (1) pylorospasm, (2) hypermotility, (3) hypersecretion and (4) hyperacidity.

In the opinion of Andresen,[12] the concept that the production of ulcer is largely the result of acid erosion of the gastric or duodenal mucosa and that treatment directed to alkalization is absolutely necessary for healing is contrary to fact and experience.

"My experience of thirty years in the treatment of ulcer," he writes, "without any attempt at acid neutralization has shown just as good if not better results than in those cases in which some such antiacid treatment has been used. After all, it is safe to assume that an uncomplicated ulcer will heal spontaneously if given a chance and that treatment must be directed to relieving the patient of hunger pains by frequent feedings of bland food while the ulcer is healing."

Evidence of the value of treatment along these lines is quite convincing. We all realize the desirability of avoiding conditions that tend to exaggerate hunger contractions, which, according to Quigley,[13] may give rise to distress and prevent ulcer healing through mechanical trauma to the area involved. Frequent feeding in peptic ulcer cases is now an established procedure. Two-hour feedings are generally given, with alkalis, or preferably one of the newer preparations such as aluminum hydrate or magnesium trisilicate, given during the feeding intervals. However, it has been observed that equally as good, if not better, results can be obtained by increasing the frequency of feeding, thus largely obviating the need for alkalis (Adams[14]). Here particularly, one should not forget that the patient is an individual with individual idiosyncrasies and dislikes with regard to certain foods.

Immediate and frequent feedings, based on the Meulengracht program,[15] give much promise of success in the management of bleeding gastric and duodenal ulcer. After a study of 1,396 recorded cases of gross bleeding from ulcer of the stomach or duodenum, including thirty-two of their own cases, all treated by a prompt feeding program and a reasonable amount of fluid, Nicholson and Miller[16] stated that results on this regimen are far better than for any other type of treatment, either medical or surgical. They stressed that the type of diet is of secondary importance, provided that it be given promptly, frequently and in adequate amounts, irrespective of the degree of bleeding.

One must not overlook the fact, however, that instances of intractable hemorrhage still require the fullest co-operation of both the internist and the surgeon.

The surgical aspects of gastroduodenal ulcer have received much consideration in the recent literature. While it is evident that a large proportion of cases of duodenal ulcer respond favorably to prolonged medical treatment, a similarly high percentage of beneficial results cannot be claimed for gastric ulcers.

By this, I do not wish to imply in any way that the presence of a benign gastric ulcer is an immediate indication for surgery. Medical treatment should be given a trial in every case in which the condition at the location of the lesion warrants such treatment. However, if after a suitable period of adequate, proper medical therapy, the ulcer fails to respond by complete disappearance, surgical intervention should not be withheld. Even so, bitter experience has taught that a thorough trial of apparently successful medical therapy cannot be relied upon to exclude the possibility that the lesion is malignant or that ulceration will not recur once the patient resumes his usual habits and activities (Walters[5]).

Unlike duodenal ulcer, surgery should not be delayed in patients with gastric ulcer in order to permit repeated trials of medical therapy. Waiting to see what will happen under various medical regimens can prove fatal and, moreover, the danger of malignancy is far too great to permit of protracted delays. The decision for or

against surgery must be made before the opportunity for operative cure is lost entirely.

It is gratifying to note the growing unanimity of opinion among surgeons regarding what is generally considered the operation of choice in gastric ulcers; namely, subtotal gastric resection (Walters,[5] Cole and Forsee[17]). Allen[9] recently wrote that "there is an increasing safety in subtotal gastrectomy that warrants eliminating the chance of overlooking malignancy in an ulcer. The results of gastrectomy in the treatment of gastric ulcer are so good that a larger percentage of such cases should be so treated."

Such opinions are based upon sober consideration of painfully gathered information. In the main, I thoroughly agree. However, as in the past, I must persist in emphasizing the importance of conservatism in gastric surgery (DeCourcy[18,19,20]). The mortality rates, though constantly improving, are still such as to indicate that radical surgery of this kind should be done only by men whose experience and constantly improving technic qualify them to do this type of operation. I am not alone in this opinion. Lahey[21] has expressed similar views.

At the DeCourcy Clinic, we have constantly been improving our technic and modifying our procedure until we have come to believe that gastrectomy, in our hands at least, is a relatively safe operation. This is substantiated by our constantly decreasing mortality figures. These results we attribute to certain modifications in operative procedures which we have adapted or developed at the Clinic.

In our procedure, we begin our resection at the upper or proximal portion of the stomach, so that dissection is made from above downward. As previously reported (DeCourcy[18,19,20]), this procedure permits us to visualize the posterior gastric wall during all the time the resection is being made. With this technic one is less likely to injure the pancreas and there is also less tendency to encounter troublesome hemorrhage in cases in which posterior adhesions have formed.

We have also found that anterior anastomosis is preferable to posterior anastomosis. Not only is it just as efficient, but I am convinced that the adoption of anterior anastomosis has been a prime factor in lowering the mortality in our cases of stomach resection. I have expressed the opinion,[20] one which I now hold more strongly than ever before, that the general acceptance of this procedure will result in a marked drop in gastrectomy mortality everywhere.

Another important element which has done much to assure better results, one which I have stressed in previous communications,[18,19] is the use of the two-stage operation. This operation, consisting of gastro-enterostomy followed after an interval by resection of the ulcerous or cancerous area, may be used with safety on elderly patients or on patients too debilitated to withstand the complete operation at one session. We have found that in many cases of ulcer the preliminary gastrectomy has resulted in cure without the need for subsequent resection. Where, however, resection is needed, the risk is greatly lessened because the previous gastro-enterostomy greatly improves the patient's nutrition and well being. By the two-stage operation patients have an excellent chance of recovery and pulmonary complications have been absent.

Much of what has been said regarding operations for gastric ulcers obviously holds true for surgery of duodenal ulcers. Here, too, where surgery is indicated, partial or subtotal gastrectomy appears to be the operation of choice among experienced surgeons (Cole and Forsee[17]). Vale[11] believes that among standard operations, resection alone completely eliminates the factors of pylorospasm, hypermotility, hypersecretion and hyperacidity. High resection, he believes, is the only way in which most patients can be permanently cured.

Follow-up studies led Allen and Welch[10] to the belief that subtotal resection is the operation of choice. In their opinion, not less than half the stomach together with the pylorus should be removed when feasible. They found that in seventy-one survivors of seventy-six subtotal resections performed during a period of thirty-four months, no jejunal ulcers had developed up to the time of submission of their report. Moreover, it was noted that the mortality following such subtotal gastrectomy in their series of cases was not greater than that following less extensive operations.

Very significant is the observation made by these authors that the trend of operation for duodenal ulcers at the Massachusetts General Hospital is away from palliative operations. This, they believe, is doubtlessly due to the very high percentage of poor results associated with these less radical operations. Conversely every patient who has had a radical resection of the distal half or more of the stomach and pylorus has remained free of symptoms and none has as yet developed recurrent or anastomotic ulcers.

This observation reflects the general trend in surgery of the duodenum and the more radical procedures are being more widely employed because better results are obtained. We must not, however, blind ourselves to the fact that there is still a place for less radical operations. Nor should it be forgotten that resection, or indeed surgery of the stomach in general, should be in the hands of skilled and experienced operators.

A growing awareness of the importance of postoperative care and follow-up after dismissal from the hospital is another good sign evident in recent reports. Postoperative care lowers mortality and hastens recovery, while the institution of a suitable, individualized regimen enables the patient to live comfortably with his newly acquired digestive arrangement. Follow-up is essential, since only by this means can we truly evaluate the worth of newer, more radical procedures in the field of gastroduodenal surgery. The same holds true for other methods of treatment.

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PENTOTHAL SODIUM OXYGEN ANESTHESIA IN MAJOR SURGERY*

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THE ideal universal anesthetic for all major surgery has not yet been found as attested by the writings of leaders in this field of medicine. The aim of this paper is to emphasize the validity of this statement by summarizing the recent literature and to present the analytical data derived from clinical observation. It is hoped that these data may lend some influence in the changing methods of anesthesia in an effort to improve the results. In this study 837† intravenous pentothal sodium anesthetics supplemented with continuous inhalation of 100 per cent oxygen were reviewed. Every operation was an elective major procedure. The anesthetic was not used for emergency operations or for patients in shock. The work was done at the Robert Packer Hospital and Guthrie Clinic from September 1, 1939, to November 30, 1941.

GENERAL CONSIDERATIONS

Anesthesia is becoming a special field of endeavor both as an art and as a science. This has resulted because of the addition of new anesthetics in such numbers as to bewilder the surgeon. Not long ago the surgeon had only to consider the general inhalation anesthetics, ether, chloroform and nitrous-oxide-oxygen, and local or spinal anesthesia. Now ethylene, cyclopropane, avertin and barbiturates (orally or intravenously) must be considered. The rapid change in the methods and drugs now used for anesthesia makes it impossible for the practicing surgeon to be an expert with each medium. The greater share of surgery for many years to come will be performed by surgeons with assistance of colleagues or nurses as anesthetists. Thus the surgeon must carry full responsibility and this in turn stimulates his interest in further developments in this vitally important field. Surgeons as a rule confine their anesthesia to a few drugs with which they are familiar and most surgeons are conscious of the injurious effects of chloroform, avertin and even ether on certain parenchymatous viscera. Many are showing discretion in their choice of anesthesia for special fields.

It appears that the art and science of anesthesia and the welfare of the patient are improved when the surgeon maintains a sense of responsibility for the patient and for the anesthetic, as the administration of an anesthetic is a major therapeutic operation. The value of good anesthesia by a trained anesthetist cannot be too strongly advised. The responsibility of the anesthetist in major operations is next to that of the surgeon. Guthrie[1] and others have pointed out that if fear can be allayed quickly by a constant stream of suggestion by the anesthetist, the patient will no doubt go to sleep quietly and recover from the anesthetic in the same state of mind. Surgical patients whose minds are racked with emotions of fear and worry are often exhausted before they are anesthetized and are fit subjects for surgical shock and death.

We are not handicapped as were the older surgeons, who, because there were no anesthetics except ether and chloroform, were obliged to hurt their patients, at times severely. The modern operator should not hurt his patients or allow them to suffer unnecessarily; the modern surgeon will not.

† Since this study was finished, a total of more than 1,200 major operations have been done with this anesthetic.

* From the Guthrie Clinic, Robert Packer Hospital, Sayre, Pennsylvania.

As Cutler, Zollinger[2] and others have stated, the advent of anesthesia introduced a new element into surgical practice, for patients could not be persuaded to accept surgical treatment for conditions other than those which were of dire necessity. Before anesthesia no patient would accept surgery and its associated pain unless serious future trouble was believed to be inevitable. Since he knew he could be made unconscious, it was far easier to do elective surgery. With the present method of intravenous anesthesia aside from offering a considerable margin of safety and a wide utility it is very acceptable to the patient. That this is true of pentothal sodium is adequately attested by the testimony of those to whom it has been administered.

In the general considerations of pentothal sodium the various factors involved in safely preparing a patient for anesthesia, their trip through the unconscious state and afterward is in no way different in most respects than the inhalation anesthetics.

Regardless of the type of risk, the patient received the benefits derived from careful evaluation of his physiological state before operation. Patients with cardiac, pulmonary, renal or liver disease, required certain studies and a careful selection of anesthesia. All the patients in this series were brought as near as possible to normal by proper remedial methods, and the procedure and anesthetic was carefully considered so that no unnecessary risk was incurred.

Accurate evaluation of postoperative complications requires review of each step in the pre- and postoperative care of the patient, as well as each step in the operation. Many complications can be avoided through constant interest on the part of the surgeon, and by bearing in mind the dangerous part drugs play, particularly morphine which decreases the depth of respiration and in large repeated doses may be sufficient to encourage atelectasis.

In the aged, local anesthesia is frequently more desirable than any general anesthetic. This is due partly because reason and education have submerged the natural fear, and partly because in the aged, viscera are likely to be abnormal, and any anesthetic which is to circulate in the body may provoke changes that cannot be anticipated.

It is obvious to all that pre- and postoperative care of the patient is more important than the agent used. Barbiturates are not analgesic. In heavy doses they depress metabolism due to decreased emotional excitability. If the reflex irritability is not sufficiently reduced, the operation should be delayed until the proper depth of anesthesia has been reached. It usually takes one to two hours for preoperative sedative medication to act and, if properly timed, it will aid the anesthetist. If only fifteen minutes are permitted to elapse between the time the drug is given and the beginning of the anesthetic, difficulty will be experienced even in the intravenous methods. To reach a proper concentration of the agent in the blood stream, the time element is a factor. This time will vary in individual cases and according to agents employed, depending upon factors such as a nonobstructed airway, circulatory activity, degree of pain, age, degree of fever, emotional disturbance, and, as Waters and Schmidt[3] have suggested, endocrine imbalance. Depth of anesthesia, regardless of the type, can be kept on a much lighter plane if the surgeon and his assistants avoid sudden pull on retractors against the peritoneum and injudicious use of packs. Anesthetic complications, deaths and undesirable factors related to anesthesia should be constantly reviewed and recorded. The ever increasing importance of anesthesia in war medicine is a subject for consideration and the injured of this war will be very thankful for intravenous anesthesia.

CHOICE OF ANESTHESIA

Many troublesome factors have been eliminated in recent years by the addition of newer anesthetics. Some writers have shown that certain general principles underlie the choice of anesthesia. Most

patients prefer to be unconscious during the operation. One cannot dissociate mind and body; therefore, insistence upon local anesthesia in a highly neurotic individual is to court trouble and perhaps disaster. In children under ten, a general anesthetic is desired. In this series, no children under ten years of age were given intravenous pentothal sodium. As mentioned by Lemmon and Paschal,[4] in local and spinal anesthesia, preoperative sedation will diminish the amount of anesthesia required and allay any mental fears the patient may have. The pharmacologic action of preoperative drugs and their relation to the anesthetic used, must be well understood when the choice of anesthesia is considered. For example, Guthrie and Hughes[5] point out that morphine or other hypnotic drugs should not be given in those instances in which avertin is to be used as the basal anesthetic augmented by a small amount of ether, ethylene or nitrous-oxide oxygen for additional relaxation.

It is not a simple matter to make the choice in any given instance, and it is not possible to say in general what anesthetic is best for any given type of operation. Experience is a large factor in the choice of anesthetics. As our experience in this clinic increased, it became a great deal easier to obtain excellent anesthesia even for the most difficult upper abdominal operation. Although ether is not the most desirable anesthetic, its availability is a factor to bear in mind. Other factors of importance are the danger and length of the operation, the characteristics of the patient, the temperament of the surgeon, the characteristics of the anesthetist and particularly his experience and ability in administering anesthetics. As mentioned by Sise,[6] it is poor policy to sacrifice more ideal operating conditions for the increased safety factors of any special anesthetic.

The qualities of an ideal anesthetic must, according to Seevers and Waters,[7] satisfy four individuals: First, the patient, who desires rapid and pleasant induction with an anesthetic which is nonirritating and free from unpleasant odor, and a recovery period free from discomfort; secondly, the surgeon, who would be satisfied with a nonexplosive agent, if it were capable of producing complete muscular relaxation without increased capillary bleeding; thirdly, the anesthetist, who desires an anesthetic with a wide margin of safety, capable of excretion from the body entirely unaltered, with a minimum of functional or organic injury during and following its use, sufficiently potent to permit the use of a high percentage of oxygen in the anesthetic inhalant mixture at all times, and to diffuse both sufficiently and rapidly to allow moment control of the depth of anesthesia; lastly, the manufacturer, who is interested in producing an anesthetic simply and inexpensively, one purified without difficulty and capable of storage without risk of chemical changes.

It is true, no known anesthetic fulfills all the qualifications listed above.

Our experience so far with intravenous pentothal sodium has been very encouraging and meets many of these requirements. Although the method of destruction in the body of this barbiturate is not clearly understood (Nicholson and Sise[8]), it has been shown that the process occurs so rapidly that scarcely a trace can be found in the secretions three to twelve hours after a single therapeutic dose, though the effect lasts from three to thirty minutes, depending upon the dose which is used. According to Mallinson[9] who recommends its use, it is one of the most valuable advances in the science of anesthesia made in recent times. As mentioned by Cameron,[10] Davison and Rudder[11] and many others, the intermittent method in which the anesthetic solution is administered permits maintenance of an even anesthesia, and the rapidity with which it is destroyed makes pentothal sodium anesthesia as controllable, consequently its use as safe, as that of any inhalation anesthetic. As noted in Table 1, its use in this clinic has increased very rapidly in the last few years. This is also true at the Mayo Clinic, according

to Lundy and co-workers.[12] Experimental workers including Kohn-Richards and Grimes,[13] Gruhzit, Dox, Rowe and Dodd[14] and many others, have demonstrated that clinical use of the intermittent method allows one dose to be partly detoxified before the next is administered. Adams[15] considers pentothal sodium the barbiturate most acceptable for anesthesia and believes there is slight hope of producing additional effective members of the barbiturate group. Butler and Bush[16] have described the prolonged and variant effects of large doses of pentothal sodium as being due to the transformation *in vivo* of the short acting barbiturates into less active compounds of more prolonged, but less intense action.

RECENT ADVANCES IN ANESTHESIA

Each year, many additions are made to the rapidly expanding field of anesthesia. Although there has been but slight advance in the development of new anesthetic agents which are superior to older agents, valuable advances have been made in the use and application of older agents and methods, with inhalation and regional anesthesia still holding their place among the standard methods. It is our hope to prove that the increasing use of intravenous pentothal sodium anesthesia for major operations is entirely justified if the patients are properly selected and if the anesthetist is trained and there is adequate available equipment.

As reported by Lundy and Adams,[17] intravenous pentothal sodium was first recommended for short minor operations; later it progressed through a development of (1) its combination with air; (2) having patients breathe a continuous supply of 100 per cent oxygen, and (3) the still later addition of varying concentrations of nitrous oxide with oxygen. The importance of oxygen as a supplement has been stressed by many writers. In the case of hepatic disease, Ravdin[18] believes the flow of blood is impaired and anoxia of the liver results, but adequate oxygenation minimizes this danger. It is his opinion that extensive liver damage occurs during ether anesthesia when the oxygen supply is reduced to 15 per cent, which concentration is 5 per cent less than air, and that frequently death is caused by anoxemia during anesthesia. Lahey[19] states that anoxemia is the basis of most anesthetic difficulties.

The continuous administration of oxygen during the intravenous anesthesia has been a fundamental improvement. It has been shown that the barbiturates as a class affect the respiration by decreasing its depth. For this reason, adequate oxygenation during a barbiturate anesthesia is obtained only by employing a concentration of oxygen higher than that found normally in the atmosphere. The continuous administration of high concentrations of oxygen during intravenous pentothal sodium anesthesia permits oxygenation to be maintained during all phases of anesthesia. Since Lundy and co-workers[20] first introduced intravenous pentothal sodium clinically at the Mayo Clinic in 1934 there has been much experimental work done to determine the minimal lethal dose of intravenous pentothal sodium in laboratory animals. This work has been of great assistance in determining the dosage for intermittent administration of the drug. It has been proved that induction of anesthesia is usually obtained by the initial administration of less than 3 mg. per kilogram of body weight and subsequent doses of less than 1 gm. per kilogram of body weight. The total amount of pentothal sodium used in an operation lasting one hour varies between 13 and 26 mg. per kilogram of body weight. Thus theoretically, there is a very safe margin between the probable minimal lethal dose in man and the amount required for anesthesia. In autopsies performed on twelve patients who died several days after operation, Carraway[21] found no pathologic changes attributable to the pentothal sodium anesthesia.

The use of intravenous pentothal sodium anesthesia has been widening and the types

of operation in which it may be used to advantage have increased. The field of application now comprises all types of surgical procedures, regardless of the operating time. The apparatus used for administration of intravenous pentothal sodium may be as simple as a sterile syringe and intravenous needle. Various new apparatus for stabilizing the source of supply of the anesthetic solution has been described by Adams,[22] Davison and Rudder,[23] and others. Some anesthetists employ a three-way valve which allows subsequent doses of the pentothal sodium solution during operation, as well as the continuous administration of intravenous fluids if the latter should be required. Hand and Sise[25] reported a precipitate formed when pentothal sodium and glucose were mixed. Blaisdell[24] and others have used various types of stands for holding the syringe containing the solution.

Pentothal sodium may be used as a supplement to local, regional or inhalation anesthetics. It is compatible clinically with all other anesthetics. Lundy and his coworkers[26] have suggested a technic by which nitrous oxide and oxygen in a fixed proportion are used as a basal anesthetic, with the addition of intravenous pentothal sodium to secure any desired depth of anesthesia. This method furnished an adequate oxygen supply, and the small doses of pentothal which are necessary make possible a shorter recovery period even after prolonged anesthesia. Adams and Lundy,[27] Hand and Sise[25] and others have demonstrated the use of intravenous penthothal sodium as a supplement to spinal anesthesia both to prolong the anesthesia when the operative procedure consumes more than the expected time, and to cause unconsciousness in the patient undergoing a long operation under spinal anesthesia. It is also used in small amounts to control nausea during spinal anesthesia.

The patient's wholehearted acceptance of intravenous pentothal sodium anesthesia has made its advancement as a general anesthetic a very rapid one. Through his personal experience, Lahey[19] calls pentothal a delightful anesthetic, and Phillips[28] believes that a patient who is able to eat a hearty lunch two hours after an operation is certainly pleased with the anesthetic.

The induction phase of anesthesia is a matter of a few seconds after the injection is made. There is no excitement during the second stage, the patient drifting into unconsciousness as if in a normal sleep. Carraway[29] mentions that this lack of excitement shortens the anesthetic time and permits the preparation of the operative site before the anesthetic is started.

The art and science of anesthesia is advancing so rapidly that a broad viewpoint regarding all anesthesia must be maintained.

Lundy[30] stresses that an anesthetic poorly timed is a disadvantage to the patient, and that many anesthetists delay unnecessarily before changing to another agent or method. This delay is no doubt due to the anesthetist's familiarity with ether, his pride in being able to anesthetize all patients with one agent or method, and his limited experience in the use of gases and/or intravenous anesthetics.

Other anesthetics have made advancements and require an open mind and a good sense of judgment to be honest and fair with each agent. For example, Lemmon and Paschal's[4] work on fractional spinal anesthesia has been widely accepted and the method has been used in this clinic with good results. Ethylene, first introduced in 1924, continues to be extensively used. There is a recent report of 35,500 cases from this clinic with gratifying results. Cyclopropane has been used extensively by the profession. It is highly explosive agent and has some action on the heart which is not completely understood. Its use in this clinic is limited to thoracic surgery. Intratracheal, local and regional anesthesia, are useful in many procedures and in the enthusiasm for newer methods their value should not be overlooked. Avertin, as a basal anesthetic, continues to be used in some institutions, but its use in this clinic

has been limited since Guthrie and Hughes[5] reported a fatality.

HISTORY INTRAVENOUS ANESTHESIA

As Tovell and Carofalo[31] state, Ore of Lyons was the first to attempt the production of anesthesia by the intravenous administration of chloral hydrate in 1872. Hedonal was employed for intravenous anesthesia in 1905, and ether was tried shortly afterward by Burkhardt[32] in 1909. Others were introduced as follows: paraldehyde in 1913, somnifene in 1924, ipral in 1925, pernocton in 1927, and avertin in 1929. These drugs were proved to be unsatisfactory for intravenous use and they have been discarded. Interest was renewed when Zerfas[33] and his associates used sodium amytal; nembutal was introduced in 1930 and evipal sodium in 1932. Pentothal sodium was first used clinically by Lundy and Tovell[34] in 1934, eunarcon was introduced in 1935, narconumal in 1936, and recently sodium thicothamyl has been added to this long list of drugs. Search for better agents continues, but so far sodium ethyl (1 methyl-butyl) thiobarbituric acid (penthothal sodium) is considered superior for the production of surgical anesthesia, while the longer acting derivatives, sodium amytal and nembutal, are reserved for the control of convulsions associated with epilepsy, eclampsia, tetanus, and strychnine poisoning. The derivatives capable of producing prolonged or sustained effect soon lost favor as surgical anesthetics because recovery was prolonged and was too frequently accompanied by restlessness of a sufficient degree to constitute a nursing problem. It may be that this trend was hastened by anesthetists who attempted to employ methods for predetermination of dosage, rather than administer those older derivatives of the barbiturate series in fractional doses during the course of surgical procedure. In spite of this, much was learned concerning these agents, and they still hold a deserved place in our armamentarium as preoperative sedatives and as satisfactory agents for the control of convulsive states, when administered intravenously or rectally in fractional doses. Adams[35] has used pentobarbital sodium (nembutal) in a 5 per cent solution intravenously, preceding a thyroidectomy, in patients having high basal metabolic rates in order to gain their co-operation during the establishment of regional anesthesia.

TABLE 1

TRENDS IN ANESTHESIA AT THE ROBERT PACKER HOSPITAL

	1937	1938	1939	1940	1941
Inhalations.....	3397	3465	3320	2629	2383
Spinals.....	96	80	111	55	86
Intravenous.....	72	185	307	943	991

The above table includes the three main types of anesthesia and shows the gradual increase in the use of the intravenous method at the expense of the inhalation anesthetics. This includes both major and minor procedures.

DeWan and Randall[36] first reported the use of barbituric acid derivatives in the Guthrie Clinic in 1936. Since that time intravenous pentothal sodium anesthesia has become the most frequent special anesthetic used. (Table 1.)

THEORIES OF ANESTHESIA

The mechanism by which anesthetics depress the activity of the central nervous system is poorly understood. Despite the large amount of investigation into the subject, the explanations are as yet hypothetical. Even the fundamental mechanisms underlying such a physiological occurrence as normal sleep are obscure. Because of the paucity of conclusive information, the following discussion of the theories of anesthesia will be brief. It should be noted in passing that this lack of knowledge has not interfered seriously with the clinical use of anesthetics or the continuous improvement in anesthetic agents and technics of anesthesia.

As mentioned by Goodman and Gilman,[37] there are many agents, physical and chemical, which are capable of producing depression of the central nervous system.

Cold, fatigue, lack of oxygen and certain ions (Br. Mg., etc.) are but a few of them. Clinical anesthesia is obtained especially by the use of the hydrocarbons of the methane series. A number of alkaloids also cause marked central nervous system depression. It is difficult, therefore, to believe that a single mechanism underlies the action of all these diverse agents. Nevertheless, numerous investigators have sought a unitary explanation by a study of the correlation between physical and chemical properties of drugs and their anesthetic potency. The result of most of the work is the belief that numerous anesthetic agents show affinities for lipids and for cell surfaces. In some instances, these affinities appear to be quantitatively related to anesthetic strength. Two theories of anesthesia have developed from the knowledge of these affinities, the one usually termed the "Meyer-Overton law" and the other known as the surface tension or adsorption theory. Several other explanations of anesthesia exist besides these two hypotheses.

PHYSICAL PROPERTIES

Pentothal sodium is a barbituric acid compound and a trade name for sodium ethyl (1 methyl-butyl) thiobarbiturate. It differs from nembutal by having one atom of oxygen on the urea side of the molecule replaced by an atom of sulfur. It is a lemon-colored powder, has a bitter taste, a slight odor of sulfur, dissolves readily in distilled water forming a perfectly clear solution with a yellowish tinge, and is alkaline in reaction. The solution is used in 1¼ to 10 per cent solution and preferably should be made up fresh as deterioration takes place in twenty-four hours. A cloudy solution should never be used regardless of how recently it has been prepared.

PHARMACOLOGICAL ACTIONS

Central Nervous System. All the numerous barbiturates have the same general type of depressant action on the cerebrospinal axis. They may be considered, at least from a clinical point of view, as differing mainly in the dose in which they are effective, in speed of onset of action, in duration of the hypnotic effects and in their usefulness for specific purposes. Any degree of depression from slight sedation to deep coma can be obtained with the barbiturates. The central depressant effects are, therefore, employed to produce calmness, to induce sleep, to depress the motor cortex and thus inhibit convulsions, and to cause partial or complete surgical anesthesia. The intensity of action obtained depends not only upon the particular barbiturate selected and the dose and route of administration employed, but also in large measure upon the reflex excitability of the patient's nervous system.

In sufficient doses, barbiturates can produce surgical anesthesia characterized by the same type of irregularly descending depression as that of volatile anesthetics. The actions of barbiturates on the brain and spinal cord, however, differ in many respects from those of the volatile agents. Much experimental work has been done by Derbyshire and his associates[38] and by Forbes and Morison.[39]

Respiration. Goodman and Gilman[37] report that large doses of barbiturates are directly depressant to the medullary respiratory center and to a lesser degree to the sino-aortic chemoreceptors. Both the rate and depth of breathing are decreased and the rhythm may be irregular. However, in therapeutic doses, respirations are regular but shallow, and may be hard to detect when the drug is used without oxygen. Pallor may be noted in some cases. Since 1938 when Carraway[21] began the use of continuous oxygen inhalations throughout the operation, almost normal respiratory excursions resulted and a normal color of the skin; in addition, muscular relaxation was somewhat increased. Blackberg and Hrubetz[40] have explained the depression in depth of respiration, as being dependent upon the concentration of the drug in the blood at any one time so that large amounts

may be given safely in broken doses over a period of time.

Fortunately, the rate of destruction of the drug given in therapeutic doses is so rapid that even though depression of respiration results in momentary arrest, breathing recurs almost before cyanosis appears.

Constriction of the bronchial musculature has been shown by Adriani and Rovenstine[41] to be due to parasympathetic stimulation which is relieved by atropine.

Cardiovascular System. The barbiturates, even when used intravenously for anesthesia, do not appear to be directly toxic to the myocardium, or seriously to alter cardiac rhythm or conduction. A sharp fall in blood pressure may result from the rapid intravenous injection of a relatively safe dose of a barbiturate, but the hypotension is transitory if the dose is not too large. Ectopic beats have been explained as being due to transitory anoxemia and vanish when oxygen is given.

A review of the literature and work done by Carraway,[21] Ruth and co-workers[42] and others reveals that no electrocardiographic change in heart function was noted. In this series irregularities noticed before operation remained unaltered by the anesthetic. In hypertensives in whom the initial fall in blood pressure is greater, it soon returns to its original level and remains so. The well recognized vasodilatation which accompanies administration of pentothal sodium has been utilized in diagnostic tests for peripheral vascular disease by Weinstein[43] and others. It has been used by Allen, Lundy and Adson[44] as a prognostic agent in the preoperative consideration of essential hypertension.

Mousel[45] is of the opinion that cardiovascular collapse, if it occurs, is secondary to anoxemia caused by prolonged respiratory arrest.

Metabolic Rate. Anesthetic doses of barbiturates definitely lower oxygen consumption, as noted by Dameshek and co-workers[46] and by Shapiro.[47]

Liver and Kidneys. Scheifley and Higgins[48] suggest that the liver is not at all concerned with the destruction of pentothal and corroborates clinical observation that hepatic damage is not a contraindication. There is still some difference of opinion in this regard. Lundy and co-workers[49] state that the site of destruction of this thiobarbiturate is not known definitely at this time. The drug leaves the blood stream within a few minutes of its introduction and its effects on most patients who have disease of the liver and kidneys do not appear to differ greatly from its effects on patients with normal organs. Therefore, we do not believe that intravenous anesthesia is contraindicated when disease of the liver or kidneys is present, but it is wise to exercise greater caution with its administration.

Preparation of the patient by use of adequate protein intake as suggested by Ravdin[50] lowers any possible liver damage. Sise[51] reports that when the liver is well supplied with glycogen and when there is no lack of oxygen during and following anesthesia, liver damage need not be feared.

Intravenous pentothal sodium has been reported by Carraway[21] as being used in cases of intensive jaundice and by Ruth and co-workers[42] in massive carcinoma of the liver.

Marshall[52] contends that intravenous pentothal sodium anesthesia should not follow the administration of sulfanilamide because of the damage that the excess sulfur might incur. Lundy and Adams[75] suggest that pentothal not be used within twenty-four or forty-eight hours after the administration of another sulfur-containing drug. Our experience has shown no untoward effects when the two drugs were used at the same time in this series of patients.

As stated by Betlach and Tovell,[53] the blood sugar determinations in ordinary patients show a slight elevation after operation, and in controlled diabetics the elevation is not sufficient to cause concern. Urinary secretion is unchanged and blood

urea determinations are the same before and after operation.

STAGES OF ANESTHESIA

Pentothal sodium is usually a rapid and smooth anesthetic and when given intravenously for the production of anesthesia, it is impossible to detect the various stages as readily as when an inhalation anesthetic is given. The patient appears to fall asleep quite suddenly during the course of the injection, sleep often interrupts the patient's conversation in the middle of a sentence, and a sign or a yawn usually precedes the closing of the eyelids before the patient lapses into unconsciousness. The period of excitement noted with other general anesthetic agents is entirely eliminated. There is no other sensation experienced, except that of falling off into a natural sleep. The stage of surgical anesthesia is characterized by diminution or disappearance of superficial and deep reflexes, constricted pupils and fixed eyeballs, relaxation of the pharyngeal structures with falling backward of the tongue and shallow respiration. Muscular relaxation is best detected in the jaw muscles. The various signs differ in accordance with the amount of drug administered and with the individual patient. When an overdose of drug is given, muscular flaccidity is marked, respirations are seriously depressed and the blood pressure falls early and rapidly to shock levels.

The first and second planes of stage III anesthesia are suitable for performance of nearly all surgical operations. Most abdominal surgery is possible in the lower half of plane II because of the maximal muscular relaxation afforded therein. As a rule, this depth is needed only until the visceral structures are explored and during peritoneal closures. The depth of anesthesia is best judged by the degree of muscular relaxation which is present; anesthesia sufficient to produce abdominal relaxation, likewise will cause complete relaxation of the muscles of mastication.

The condition of the patient must be watched carefully by constant observation of the blood pressure, the rate and volume of the pulse, and the color of the mucous membranes and nailbeds. Since respiration may be all but imperceptible, Lundy[20] has devised a cotton "butterfly" which he attaches to the patient's upper lip so that the movement of air through the nostrils may be visualized. If oxygen is administered by one of the several masks, the rise and fall of the bag is an excellent means of following the rate and depth of respirations.

TABLE II

Minutes	No. of Cases	Percentage
0– 20	163	19.42
21– 30	91	10.84
31– 40	81	9.65
41– 50	96	11.44
51– 60	100	11.91
61– 80	145	17.50
81–100	77	9.17
101–120	40	4.76
121–180	40	4.76
181–over	4	0.47
Total	837	

The above table illustrates the distribution of the major cases according to the elapsed time of the anesthetic.

Several writers have mentioned that a widely dilated pupil with a fixed eyeball means momentary overdosage, while a widely moving eye with a pupil of normal size and activity indicates returning consciousness. A desirable state of surgical anesthesia is indicated by a fixed or slowly moving eyeball with a moderately dilated pupil reacting sluggishly to light.

PREOPERATIVE PREPARATION

Preoperative sedation with a "heavy" barbiturate, an opiate, and atropine is considered generally to be desirable, although a few anesthetists prefer to use nothing besides atropine preoperatively in order to avoid undue depression during and following operation. Long, Mickal and Ochsner[54] studied fifty patients undergoing thyroidec-

tomy and demonstrated that postoperatively the elapsed time before recovery from the anesthetic was much shorter in

FIG. 1. Pentothal sodium oxygen anesthesia in progress showing the Boothby-Lovelace-Bulbulian mask, the Blaisdell apparatus for intermittent injection and other equipment used during the procedure.

FIG. 2. Illustrating usual type venipuncture with 20 cc. syringe and No. 20 needle.

those patients receiving little preoperative sedation and intravenous pentothal anesthesia supplemented by ethylene and cyclopropane, than in those patients receiving a "heavy" barbiturate preoperatively and inhalation anesthesia alone. Mousel and Lundy,[55] Mackintosh and Pask,[56] Carraway[21] and others believe that atropine minimizes excessive tracheobronchial secretions, and, by decreasing vagal tone, acts as a prophylactic agent against transitory hiccoughing, sneezing and laryngeal spasm which have been observed infrequently during the induction of the anesthesia. In this series of cases only morphine sulfate gr. 1/6 (0.01 Gm.) and atropine sulfate gr. 1/100 (0.0006 Gm.) were given hypodermically thirty to forty-five minutes preoperatively.

ADMINISTRATION

Ordinarily two anesthetists are required to administer oxygen and the intravenous anesthetic, but since the advent of various mechanical devices (Fig. 1) only one is now required.

As reported by Hawk,[57] the technic of administration in this clinic has remained practically the same for several years. The patient is placed on the operating table and adjusted in the position desired for operation. The arm selected for injection is brought out to a right angle with the body and attached to an arm rest. A soft rubber tubing tourniquet is applied to the arm to distend the veins and the needle is inserted into the vein. A No. 20 gauge needle is placed on a 20 cc. syringe (Fig. 4), or if the mechanical apparatus is used, the needle is attached to sterile standard tubing that connects with the 20 cc. syringe held stationary in its receptacle. (Fig. 2.) The patient is then asked to count slowly and 2 cc. of a 5 per cent pentothal sodium solution is injected during the first ten to fifteen seconds. After a short pause to determine any idiosyncrasy to the drug and allow for even distribution in the blood stream, the injection is continued slowly until the patient stops counting. At this stage the eyelids are closed, respirations are shallow, and the jaw muscles relaxed. A Boothby-Lovelace-Bulbulian mask with respiratory bag is then applied and the jaw is supported by the anesthetist. (Fig. 3.)

The oxygen inhalations are started with a flow of about four liters a minute, but since the vital lung capacity varies in different individuals, it may be necessary to increase the flow of oxygen to five or more liters per minute. The rise and fall of the respiratory bag demonstrates the respiratory excursions. No additional solution should be injected until satisfactory respirations are established.

No established dosage can be indicated because of the marked variation in indi-

vidual susceptibility, but it has been stated by various writers that the necessary dosage varies directly as the muscular component of the patient. The toxic, anemic or cachectic patient usually requires a proportionately smaller amount. For the usual individual 4 to 8 cc. of a 2.5 per cent solution is required for induction of anesthesia and additional administrations of 1 or 2 cc. spaced fifteen to twenty seconds apart, as the indications arise. A total of 1 to 2 Gm. is usually sufficient to maintain adequate relaxation for an hour's anesthesia. It usually requires about three to five minutes to produce a state of surgical anesthesia. An increase in the respiratory rate, slight muscular movements and return of the swallowing and eye reflexes are signs that the patient is coming out of the anesthesia. It has been repeatedly noticed that skin incisions, unless the skin was previously anesthetized by local anesthesia, require more anesthesia to relieve pain than many major operations.

As Ruth[42] and others have stressed, experience in the administration of the anesthetic is the predominant factor in the problem of timing the rate of injection. It appears that it is a mean between a rapid injection which quickly depresses the respiratory center and an injection which is sufficiently retarded to allow for the drug's detoxification before anesthetic concentrations are produced. The function of respiration must be further protected by diligent maintenance of a patent respiratory tract. Relaxation of the soft tissues about the upper respiratory tract is likely to occur and thereby impinge on its patency. At the same time, obtundation of both pharyngeal and laryngeal reflexes does not occur until quite profound anesthesia has become established. Therefore, when an adequate airway cannot be maintained by proper position of the head, insertion of a pharyngeal airway may be necessary.

Recovery from the anesthetic occurs more quickly when the total dose of pentothal sodium is small. If possible, the anesthesia should be lightened toward the end of the operation in order that patients may respond before leaving the operating table. (Table III.)

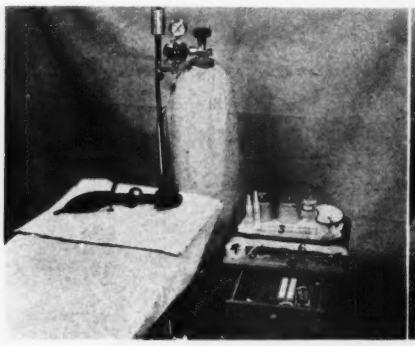

FIG. 3. Equipment needed for administration of intravenous anesthesia and 100 per cent oxygen: (1) Boothby-Lovelace-Bulbulian mask with respirator and oxygen tanks; (2) alcohol sponge; (3) syringe and needle; (4) adhesive tape; (5) airways; (6) tourniquet; (7) table.

FIG. 4. The equipment for the sterile intravenous anesthesia tray.

TABLE III
CHART FOR TIME OF RECOVERY AND AMOUNT OF ANESTHETIC

Amount Anesthetic (Average)	Recovery Time (Average)
35.4 cc. of 5 per cent 50.3 cc. of 2½ per cent	2 hrs. 36 min.
Greatest Amount Anesthetic	**Longest Recovery Time**
115 cc. of 5 per cent	18 hrs. 5 min.
Smallest Amount Anesthetic	**Shortest Recovery Time**
3.5 cc. of 5 per cent 11 cc. of 2½ per cent	5 min.

The above table illustrates the direct relation between the amount of anesthetic used and the recovery time. Recovery time is measured from the time of the last injection of the intravenous drug.

Near the close of the operation the needle may be withdrawn and a sterile cotton sponge applied with adhesive tape. If the respirations have been shallow, hyperventilation by carbon dioxide oxygen mixture is used. If a mechanical airway is necessary to prevent the falling back of the tongue, the patient is sent back to his bed with this in place. Earlier in the work, coramine or picrotoxin was given intravenously to hasten recovery, but this has since been discontinued.

Since it has been shown by Lundy[58] that the incidence of phlebitis in the vein receiving the solution is directly proportionate to the concentration of the drug (one case in 1,000 with the use of 5 per cent solution; one case in 3,000 with 2.5 per cent solution), a concentration of 5 or 2.5 per cent solution is usually employed for induction of anesthesia while a 2.5 or a 1.25 per cent solution may be used for subsequent injections.

SYMPTOMS AND TREATMENT OF OVERDOSAGE

An overdosage of intravenous pentothal sodium results in imperceptible respiration. Cessation of respiration is usually accompanied by the development of cyanosis. Pulse rate increase and muscular relaxation become marked. Treatment consists in stopping the administration of the intravenous anesthetic, establishing an airway and performing artificial respiration. Oxygen and carbon dioxide should be administered and respiratory stimulants such as nickethamide, metrazol or picrotoxin, should be injected intravenously in sufficient dosage to obtain a stimulation of respiration. Lundy[59] believes the general tendency is to abandon the routine use of respiratory stimulants.

POSTANESTHETIC MANAGEMENT

After operation the patient must be attended constantly until his reflexes return. It is usually necessary to support the jaw during a part of this period. This particular precaution cannot be too strongly emphasized. Lundy[60] advises the continuous administration of oxygen until signs of recovery appear.

It has been mentioned by many writers that one of the most desirable characteristics of the recovery period following intravenous pentothal sodium is the patient's freedom from nausea and vomiting. In this series, nausea and vomiting occurred in only 30 per cent of the cases. Cameron[10] and others have noticed that vomiting is absent in patients who have had no preliminary medication. Vomiting is a severe handicap, particularly to the diabetic patient, and makes the selection of anesthetic agent and a preanesthetic drug particularly desirable in this group of patients. Lundy and Tovell,[20] Carraway[21] and others have observed the absence of sweating at the time of the operation and during the recovery period. It is believed this characteristic must be partially responsible for the fact that shock seems to be less than after other types of anesthetics.

Following short operations, the length of the recovery period is extremely short, being calculated by Cameron,[10] Lundy, Touhy and Adams[61] and others, as from five to thirty minutes. Its length is approximately proportionate to the amount of the drug administered. Davison and Rudder[11] pointed out, and it was found true also in this series following the longer procedures, that full recovery may be delayed for as long as six to twelve hours or longer. However, even in these cases, the patient may be aroused in from ten to sixty minutes, although undisturbed he prefers to sleep on. As noted in Table III, there are wide variations in reaction times but no ill effects followed many hours of sleep.

ANESTHETIC ACCIDENTS AND COMPLICATIONS

According to Guedel's classification,[62] a number of accidents and complications may occur incident to the administration of an anesthetic. This is true both in inhalation and in intravenous anesthesia.

It is important to anticipate and prevent these, for they may prove fatal.

The principal causes of dangerous hypotension during anesthesia are hemorrhage and shock. Regardless of the etiological mechanism, the ultimate result is tissue anoxia. Hemorrhage is mainly a surgical problem and until transfusions can be performed, intravenous administration of fluids and the inhalation of a high percentage of oxygen are helpful. Carbon dioxide may also be given because it increases the tone of arterial walls.

Shock, whether due to the anesthetic or to the surgical procedure, has the same underlying pathological physiology. It can be prevented by avoiding anesthesia deeper than is absolutely necessary, by conserving body heat and moisture, by maintaining an optimal carbon dioxide level, by allowing sufficient oxygen at all times, and by treating the tissues gently.

As seen only in stage 1, respiratory arrest occurs from breath holding and is due to emotional disturbance or laryngeal irritations. Pharyngeal spasm which appears at the end of stage 1 is more troublesome and may persist intermittently through stage II. Attempts to maintain an airway or force oxygen past the obstruction usually fail, and one must wait until the carbon dioxide concentration rises and the oxygen content of the blood falls sufficiently to break through the spasm and stimulate breathing.

If the muscles of the lower jaw are sufficiently relaxed, the base of the tongue may obstruct respiration by falling against the posterior wall of the pharynx. This has been misnamed "tongue swallowing" and is rarely observed during the first two stages of anesthesia, but may occur after the patient is returned to his bed if he is placed in supine position. The danger may be circumvented by the use of a pharyngeal

TABLE IV

POSTOPERATIVE COMPLICATIONS INTRAVENOUS PENTOTHAL SODIUM

Type of Operation	Amt. Anesthetic		Reaction Time	Complication
	C.c.	Per Cent		
Cholecystectomy and appendectomy	40	5	47 min.	Atelectasis rt. lower lobe
Posterior Gastro-enterostomy	40	5	1 hr. 25 min.	Pleurisy (left side)
Supravaginal hysterectomy	20	5	1 hr.	Diaphragmatic pleurisy left
Cholecystectomy	21	5	25 min.	Pulmonary infarct, left
Bilateral inguinal herniorrhaphy	35	5	1 hr. 15 min.	Pulmonary embolism
Bilateral inguinal herniorrhaphy	41	5	1 hr. 30 min.	Atelectasis rt. lower lobe
Bilateral inguinal herniorrhaphy	70	5	6 hr. 50 min.	Atelectasis rt. lower lobe
Left radical mastectomy	24	5	1 hr. 30 min.	Infarct rt. lower lobe
Open reduction fractured ankle	47	2½	1 hr. 10 min.	Coronary occlusion
Nicola operation on shoulder	89	5	5 hr. 45 min.	Pneumonia, broncho
Plastic operation on hip	75	5	5 hr. 40 min.	Mild slough at site of injection drug
Unilateral herniorrhaphy and repair undescended testicle	46	5	9 hr. 40 min.	Atelectasis rt.
Appendectomy and exploration abdomen	48	5	1 hr. 5 min.	Bronchopneumonia
Cholecystectomy	56	5	5 hr. 10 min.	Diaphragmatic pleurisy and rt. atelectasis
Cholecystectomy and thyroidectomy	63	5	4 hr. 5 min.	Slough at site injection in arm
Total hysterectomy	58	5	2 hr. 20 min.	Atelectasis rt.
Cholecystectomy and repair ventral hernia	54	5	5 hr. 20 min.	Massive collapse rt. lung

The above table illustrates the type of major operation, the amount and percentage of pentothal sodium used, the reaction time and the complication. This is the total list of complications that occurred in 837 consecutive major operations.

airway or by holding the lower jaw forward. Another form of mechanical respiratory obstruction is due to the aspiration of débris. Foreign objects may lodge in the pharynx, trachea, bronchi, or, if liquid, in the lungs. Teeth, sponges, instruments, blood, pus or mucus are the common offenders. Secretions of mucus should be controlled by adequate doses of atropine or scopolamine.

Massive collapse of the lung, when it occurs, is usually secondary to anesthesia and follows shallow respiration and bronchial obstruction, particularly from mucus. Atelectasis is due to complete absorption of gases by the blood flowing through the lung distal to an occlusion of a main bronchus, and occurs within a few minutes. It may not be noticed if a closed system with oxygen tension is being used. However, as soon as the anesthetic is stopped, cyanosis and dyspnea are apparent and physical examination reveals evidence of pulmonary collapse. As noted in Table IV, one case of massive collapse of the lung occurred in this series of seventeen complications and immediate treatment by means of aspiration and hyperventilation effected his prompt recovery. Atelectasis often results in serious postoperative pneumonia. Prevention depends upon maintaining sufficient depth of respiration by inhalation of carbon dioxide and vigorous hyperpnea induced with carbon dioxide at the end of each operation in which breathing has been shallow. In treating fully developed atelectasis, oxygen and carbon dioxide should be administered for an hour or longer and direct bronchoscopic removal of the mucous plug may be attempted, if early evidence of improvement is not forthcoming. As noted in Table IV, six cases of atelectasis developed in this series and all recovered after the above treatment was instituted.

Long and Ochsner[63] have reviewed a large collection of intravenous pentothal sodium anesthetics and state, "remarkable in this collection of 54,851 cases is the absence of any single report of postoperative pulmonary collapse or pneumonia; symptoms of milder respiratory complications were almost as rare."

ANESTHETIC DEATHS

There were no deaths in this series of major operations. Two deaths, however, have occurred during minor operations, both patients having been known to be long-standing heart cases with previous proved coronary thromboses. It is desired to emphasize that the anesthetic is not always the cause of death. Indeed, the cause may be extremely difficult to determine.

Death from pentothal sodium, if it occurs early, is usually the result of paralysis of the respiratory center. The shorter acting barbiturates are particularly prone to produce death from respiratory depression. If death is delayed, vasomotor collapse and hypostatic pneumonia are frequently the causes of the fatal issue. Bronchopneumonia may occur in a patient who has regained consciousness and apparently recovered, and in this complication a guarded prognosis is advisable. The cerebral changes which occur in a fatal case have been described by Hassin[64] as a morphological alteration of ganglion cells in the brain, being usually marked in the medulla and olivary bodies, and often associated with neuronopagy without marked macroglial or microglial reactive phenomena. More important and dangerous is the occurrence of cerebral edema with distention of the subarachnoid space and the cerebral tissue spaces. Beecher and Moyer[65] have done extensive work on the mechanics of respiratory failure in deaths from barbiturate anesthesia.

As stated previously, in twelve autopsies on patients who died several days after pentothal sodium anesthesia, Carraway[21] found no pathologic changes attributable to intravenous pentothal sodium. Weese,[66] in calling attention to a number of deaths reported during operation done under various intravenous barbiturate anesthetics for sublingual infections, advances the following interesting explanation on the basis of experimental work performed on dogs.

Infection in the area of the carotid sinus which normally exerts an inhibitory effect on the respiratory center, increases the sensitivity of this structure by impairing its blood supply. When infection is present, the fast acting intravenous barbiturates anesthetize the central nervous system more rapidly than they anesthetize the carotid sinus. If the carotid sinus is traumatized by an operation begun during this phase of anesthesia, such powerful inhibition of the respiratory center may result in death. Weese advises that anesthesia continue for at least five minutes before the beginning of any operative procedure for infection in the neck, so that sufficient time will be allowed for the anesthetizing of this portion of the vagus system.

ANESTHETIC CHARTS

As noticed in Tables v, vi and vii, careful records of every anesthetic is kept. Cutler and Zollinger[2] have written that nothing

Table v

ANESTHESIA AND OPERATION RECORD

Name.....Age....Date.....No. B....
Surgeon.....Assistant.....
Surgical Nurse.....Doctor Referring.....
Operation started.....Operation ended.....
Drainage.....Packs {Used..... Recovered.....
Closure.....

Pulse	Respirations	Anesthetic
.....	.....	Ether...Gas... Local...Intravenous... Charge $.....

Comments.....
.....
Operation.....
.....

The above record is filled in at the head of the table before and during operation and then is given to the operating room stenographer to transcribe on the permanent operative record.

contributes so greatly to the full appreciation of the patient's condition at any given time as the data on these charts.

In addition to furnishing vitally important information during the ordeal, this chart contains specific information concerning the general condition of the patient. It should show pre- and postoperative diagnosis in order to provide an educational check and stimulus to the staff. It should also contain a correct title of the procedure for the benefit of the record room staff of institutions where proper listing is kept of

Table vi

Operative Record ROBERT PACKER HOSPITAL Sayre, Pa. B

NAME DATE

Postoperative Diagnosis

Preoperative Diagnosis

Surgeon Assistants

Referring Doctor | Anesthetist | Respiration | Pulse | Blood Pressure

Operation Started Operation Ended

Sponges Used Sponges Recovered
Packs Used Packs Recovered
Instrument Nurse Sponge Nurse

Anesthetic Amount cc

Summary

Drainage

Pathological Report

Operative Findings

Operative Procedure

Signature of Surgeon

The above record is the permanent operative record that includes all that takes place in the operating room and is completed at the close of each operation by dictation to a full-time medical stenographer and then signed by the surgeon himself.

surgical operations and of diagnoses. Comments by the anesthetists or surgeons are made on the face of the records and are valuable in the study of postoperative pulmonary complications. The notation of drains may save much worry in the postoperative period when memory often fails one. All pertinent information about the amount of anesthesia, who gave it, time of operation and the operative procedure, is a part of the chart. This chart is then incorporated in the main record which carries exactly the same house number for all departments and on all subsequent admissions to the clinic or hospital. The patient is never seen without the entire

record being at hand. Special charts as noted in Table VII have been kept when new anesthetics are used in order further to evaluate their usefulness.

TABLE VII

SPECIAL ANESTHETIC RECORD SHEET

Anesthetic No. .....

THE ROBERT PACKER HOSPITAL

Case No. B.... Room.... Ward.... Date.....
Patient's Name..... Age....
Operation.....
Anesthetist.....
Type Anesthetic Drug.....Total Amount.....
Operation Started..... Ended..... % Concentration.....
Anesthetic Started..... Condition at start.....
Condition during Anesthetic
B. P. Start ..... B. P. Finish .....
Nausea ..... Hiccoughs .....
Vomiting .....
Relaxation .....
Oxygen Used .....
Postoperative Reaction
Time Reacted ..... B. P. .....
Nausea .....
Vomiting .....
Gas Pains .....
Distention .....
Remarks.....

The above record sheet was kept on all patients receiving pentothal sodium oxygen anesthesia and their postoperative course was followed until the patient left the hospital.

POSTOPERATIVE SEDATION

Sedatives should be given with caution after all major abdominal or thoracic operations. In this type of case, deep and regular respiration may prevent postoperative pulmonary complications. After operation sedatives should be given sparingly in all cases in which there is evidence of mucus in the respiratory tract during anesthesia. If such patients are allowed to recover from the anesthesia and postoperative sedation sufficiently, the cough reflex returns and they can be encouraged to breathe deeply and to cough up the mucus. If mucus is left in the trachea and bronchi, and if the lower lobes of the lungs are not fully expanded, atelectasis and pneumonia may develop later. These simple precautions have been mentioned by Mousel and Lundy[67] and many others.

It is believed that postoperative pneumonia often is preceded by pulmonary atelectasis. Tracheobronchial aspirations should be carried out before the patient is removed from the operating room in every major surgical case in which there is evidence of mucus in the trachea. This may be done under direct vision of the bronchoscope whenever possible, and one should have no hesitancy in bronchoscoping a patient postoperatively if an atelectasis or massive collapse is present.

SPECIAL FIELDS OF USE

In perusing the literature, one is impressed with the diversity of opinions concerning the scope of the usefulness of pentothal sodium. Many clinicians, including Adams,[68] Cameron,[10] Pratt, Tatum, Hathaway and Water,[69] Ruth, Milligan and Charleroy,[42] advise its use only for short operations not requiring marked muscular relaxation. This group lists as contraindications such conditions as asthma and cardiac decompensation, and contends that abdominal operations and other procedures requiring muscular relaxation are not feasible under pentothal sodium. Still others, including Carraway,[21] Kassebohm and Schreiber,[70] Thomas[71] and Tucker,[72] have doubted that there are any contraindications to its use, and indeed list so-called contraindications as actual indications for intravenous pentothal sodium. During the last three years, anesthetists who were at first very cautious in the use of pentothal sodium have found wider uses for the method.

Jarman,[73] Moore[74] and Phillips[28] have found intravenous pentothal sodium valuable in the exigencies of military surgery. It is of particular value to victims of chemical warfare when it is desirable to use an anesthetic agent which is not irritating to the lungs. Solutions are relatively stable for from twenty-four to forty-eight hours, and as much as 500 cc. can be made up at once and used over that period. Because of the availability of the drug, the ease with which it is transported and administered, the short induction time and quiet recovery, valuable time and energy may be conserved when one trained anesthetist must be responsible for numerous anesthesias in a short period.

While intravenous pentothal sodium is employed by some surgeons as the anesthetic of choice in all surgical procedures, its use is limited to certain operations by others. The absence of the anesthetist and his apparatus from the region of the operative field, makes the use of intravenous pentothal sodium desirable in operations on the head and neck, and in those cases in which the use of the cautery or electrosurgical unit creates a distinct fire hazard. It is reported as a desirable anesthetic by urologists, ophthalmologists, psychiatrists and neurologists, bronchoscopists and laryngologists, and obstetricians.

Adams,[75] Lundy and Adams,[76] Priestly and Schulte[77] and others point out that the elderly and debilitated tolerate intravenous pentothal sodium especially well. They also mention that it is a method of choice not only in the poor risk groups, but also in diabetes, myocardial degeneration, asthma, chronic bronchitis and pulmonary tuberculosis.

Lundy,[34] Lundy and Tovell[20] and Mallinson[9] have reported its use in patients in whom, for one reason or another, inhalation and spinal anesthetics are contraindicated. As mentioned before, the absence of sweating during the operation and recovery period must be partially responsible for the fact that shock seems to be less than after other types of anesthesia. In this series no patients were operated upon while in shock and no patient developed shock during or after operation.

ADVANTAGES OF PENTOTHAL SODIUM

Aside from the importance of the safety factor, the degree of muscular relaxation produced by an anesthetic is the next principal requisite. In this series, it was found that intravenous pentothal sodium anesthesia, supplemented by continuous inhalation of 100 per cent oxygen, produced muscular relaxation equal to that of spinal anesthesia. This observation is so important it should be stressed, as many authors do not agree. The concomitant use of oxygen and intravenous pentothal sodium thus permits the maintenance of a depth of anesthesia allowing complete muscular relaxation, and makes intravenous pentothal sodium more widely applicable in various surgical procedures. At the same time, the more quiet breathing is in itself a considerable advantage in that abdominal operations are complicated less by interruption from straining and forceful respiration than under any other form of anesthesia. Carraway,[21] Organe and Broad[78] and others believe this factor undoubtedly has considerable effect in increasing the speed of operation and in reducing the morbidity therefrom.

Because of the similarity of the mode of induction to the universal "blood test," the usual apprehensive thyrotoxic patient may be put to sleep in her room without any knowledge that operation is contemplated. Long, Mickal and Ochsner[54] have shown that the wisdom of this method of induction is reflected in the lessening of postoperative reaction in the hyperthyroid patient, as demonstrated by lowered pulse and temperature curves.

DISADVANTAGES

Pentothal sodium oxygen anesthesia requires two experienced anesthetists to administer it safely and they must be prepared to meet all anesthetic emergencies at all times. This is particularly true for prolonged procedures. For major procedures, these requirements would limit its employment to hospitals except in rare instances. The time that an attendant remains with the patient after his or her return to bed should be considered a minor disadvantage. As mentioned by Hawk,[57] the ease of administration is considered a disadvantage, since the drug can be used without oxygen and the only equipment necessary consists of a 20 cc. syringe, a 20-gauge needle, distilled water, and the ability to puncture a vein, thus enabling the experienced to use it in the office or home without the proper means of meeting an emergency. The elimination of the very young as desirable candidates for this type

of anesthesia may be regarded as a disadvantage. Whether the early detection of a postoperative hemorrhage, as might occur in a gastric resection, could be observed during the recovery period is subject to consideration. No postoperative hemorrhage occurred in this series.

COMPLICATIONS

The incidence of postoperative complications is no greater with pentothal sodium oxygen anesthesia (Table VIII) than with ethylene anesthesia. According to Table IV,

TABLE VIII
POSTOPERATIVE COMPLICATIONS

	Intravenous Pentothal Sodium		Ethylene	
	Cases	Complications	Cases	Complications
December 1939.	21	1	95	1
January 1940...	72	2	81	1
March 1940....	63	2	60	3
April 1940.....	65	1	79	1
May 1940.....	103	1	61	0
July 1940.....	69	1	88	0
August 1940....	98	1	84	0
September 1940	84	1	56	2
October 1940...	90	1	67	0
April 1941.....	100	1	64	2
May 1941.....	83	1	74	0
September 1941	83	3	72	1
October 1941...	97	1	54	2
Total.....	1028	17 (1.8%)	935	13 (1.3%)

The above table lists all complications that occurred in patients having pentothal sodium oxygen anesthesia as compared with those having ethylene anesthesia during the same months. Only the months when complications occurred are listed and all cases both major and minor are listed.

one patient suffered a mild coronary attack several days after operation and two developed pneumonia. Atelectasis occurred no more frequently than after other types of general anesthesia, which may possibly be due in part to the rigid routine postoperative regimen for all patients anesthetized with intravenous pentothal sodium. The postoperative regimen includes deep breathing and leg exercises twice daily for five minutes and ventilations with carbon dioxide several times a day when indicated. A minimum amount of sedation should be given until the patient is completely conscious. Four patients developed induration at the site of injection of the intravenous pentothal sodium and in two patients a slough of a small area of skin occurred. (Table IV.) There have been fewer cases of venous thrombosis and sloughing since the use of 2.5 or 5 per cent solutions has been adopted. There are scanty reports in the literature regarding complications following intravenous pentothal sodium anesthesia.

ANALYSIS OF CASES AND STATISTICS

In this clinic, the first approach to the use of pentothal sodium as an intravenous anesthetic was with caution. As reported by Hawk,[57] it was first used for minor operations. Major operations were first performed under intravenous pentothal sodium anesthesia after Carraway[21] introduced the method of using continuous inhalation of oxygen during the operation. The beneficial effects of oxygen permitted its use for all types of surgical procedures with certain limitations and few contraindications. The following data have been tabulated only in those cases in which oxygen was used and only in major operations. The 837 cases used in this study

TABLE IX

Age in Years	No. of Cases	Per Cent of Cases
1–10	3	0.03
11–20	123	14.6
21–30	128	15.2
31–40	142	16.9
41–50	177	21.1
51–60	117	13.9
61–70	104	12.4
71–80	40	4.7
81–90	3	0.03

The above table illustrates the age grouping of major operative cases receiving pentothal sodium oxygen anesthesia.

make up only 33 per cent of the total number of intravenous pentothal sodium anesthetics given during this period. The remaining 1,700 minor operations are not included in this report.

The average amount of 5 per cent solution required for induction was 3.98 cc. and 5.41 cc. of a 2.5 per cent solution, with 1 cc. being the smallest amount in both strengths and 10 cc. of the 5 per cent and 11 cc. of the 2.5 per cent the largest amount. This tends to show that the amount of agent required to produce anesthesia varies with each individual, as noticed in Table III. A grouping of ages in Table IX disclosed that 264 of the 837 patients were beyond the age of fifty years. Of these, 104 were between sixty-one and seventy, forty between seventy-one and eighty and three between eighty-one and ninety years. The youngest patient was ten years old and the oldest eighty-two years.

These figures tend to show that the anesthetic can be safely used for individuals past middle life. The reaction time may occur a few minutes after the anesthetic is stopped in shorter procedures, but in longer operations it varies in length in direct relation to the time consumed, as noted in Table III. The average reaction time in this series of major procedures was two hours and thirty-six minutes, with one patient requiring eighteen hours and five minutes before responding. The two longest operations were similar orthopedic procedures lasting over three hours; the one required 97 cc. of a 5 per cent solution and had a reaction time of three hours and fifty-eight minutes, and the other required 50 cc. with a reaction time of two hours and ten minutes.

A prolonged sleep often followed the reaction time with one patient sleeping approximately ten hours before recovery was complete, but no ill effects have been noted from either the long reaction time or recovery period. The incidence of hiccoughs was .03870 per cent. All patients received atropine preoperatively which prevented bronchial and pharyngeal secretion. Nausea and vomiting were recorded in 30 per cent of the cases, but this figure includes a number of questionable cases of nausea. There were no fatalities in this series due to anesthesia.

TABLE X

TYPES OF MAJOR OPERATIONS PERFORMED WITH PENTOTHAL SODIUM OXYGEN ANESTHESIA

Types	No. of Cases
Salpingectomy	6
Appendectomy	122
Cholecystectomy	80
Supravaginal hysterectomy	65
Cholecystostomy	5
Herniorrhaphy	82
Bone plastic operation	33
Vaginal hysterectomy	27
Total hysterectomy	8
Mastectomy	28
Oophorectomy	21
Laparotomy (abdominal)	21
Bowel resection	12
Suprapubic cystostomy	17
Open reduction bone	23
Hysteropexy	13
Reduction of fracture	11
Suprapubic prostatectomy	9
Gastro-enterostomy	12
Ligation both tubes	14
Tendon plastic operation	12
Arthrotomy	8
Enterostomy	5
Colostomy	7
Nephrectomy	9
Arthroplasty hip	10
Arthrodesis major joint	3
Gastrostomy	4
Ileo colostomy	3
Gastric resection	4
Splenectomy	2
Amputation leg	2
Ureterotomy	3
Vaginal myomectomy	3
Choledochostomy	7
Perforated duodenal ulcer	1
Pyloroplasty	4
Resection scalenus anticus and unilateral thyroidectomy	1
Cholecystogastrostomy	1
Disarticulation hip	1
Fusion spine	2
One stage abdomino-perineal resection colon	2
Closure disruption abdominal wound	2
Nephrostomy	2

As noticed in Table X, various types of major operations were done. Operations on the biliary system often prove difficult at best and a great deal depends upon the anesthetic for exposure; ninety-two operations were performed on the gallbladder

and ducts under this form of anesthesia with gratifying results. The quiet, even respirations, satisfactory relaxation, and the ease of control of any straining allowed adequate exposure in fifteen to twenty seconds by an additional injection of 1 cc. of the solution. Muscular relaxation is the main reason given for using spinal anesthesia in performing gastrointestinal surgery, but, as noted in Table X, in fifteen bowel resections, twelve gastro-enterostomies, four gastric resections, seven colostomies and three ileocolostomies, relaxation was found to equal that of any other anesthetic.

TABLE XI
APPROXIMATE COST OF INTRAVENOUS ANESTHETIC EQUIPMENT

1. Oxygen tank each	$16.00
2. Boothby-Lovelace-Bulbulian mask and valve adapter	78.00
3. Pentothal sodium—1 Gr. ampoule	.67
4. Water—20 cc. ampoule	.18
5. One 20 cc. syringe	2.00
6. Number 20 needles, per dozen	1.50

In pelvic cases first placed in the Trendelenburg position before the anesthetic was started, there were sixty-five supravaginal hysterectomies, thirteen hysteropexies and twenty-seven operations upon the tubes and ovaries. On opening the abdomen, it was found that the intestine had in many cases gravitated out of the pelvis, requiring only the insertion of a part of a gauze pack to obtain exposure. The prostatic case is often a problem from an anesthetic standpoint due to age and poor physical condition, but in nine suprapubic prostatectomies, no difficulties were encountered. In twenty-eight simple and radical mastectomies, nine nephrectomies and twenty-seven vaginal hysterectomies, the anesthetic proved very satisfactory.

The cost of intravenous pentothal sodium oxygen anesthesia, as noted in Table XI, is no greater than the other general anesthetics when used in institutions with trained, full-time anesthetists and used with equal frequency.

SUMMARY

This study is based on a review of available recent current literature, and on data derived from 837 cases in which a major operation was performed under intravenous pentothal sodium oxygen anesthesia from September 1, 1939, to November 30, 1941.

A discussion of the history, pharmacologic action, indications, advantages, disadvantages, deductions and statistics on this type of anesthesia has been presented, based on the conclusions of other authors and the data in this series. Tables presenting statistical data and figures illustrating the technical points in administration of the anesthetic are also included.

CONCLUSIONS

The following conclusions have been drawn from a study of 837 intravenous pentothal sodium anesthesias supplemented with continuous inhalation of 100 per cent oxygen: (1) The anesthetic was used in only elective major surgical procedures. (2) No patient in shock was operated upon. (3) It is a safe anesthesia that permits muscular relaxation equal to that of spinal anesthesia. (4) There is no explosion hazard. (5) Only trained anesthetists who have adequate equipment at hand should administer the drug. (6) The maintenance of an adequate airway at all times is an absolute necessity. (7) The continuous inhalation of a high percentage of oxygen prevents serious complications and death.

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ACUTE CHOLECYSTITIS

CERTAIN PATHOLOGIC AND SURGICAL ASPECTS

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MANY articles dealing with acute cholecystitis have appeared in the literature during recent years. Judd and Phillips, in 1933, reported the results of treatment at the Mayo Clinic of 508 patients who had acute cholecystic disease. Wesson and Montgomery reported on eighty-seven more patients encountered from January, 1934, to July, 1936. The present study was undertaken for the purpose of surveying a more recent group of patients with particular reference to the progress of the pathologic process and the influence this progress might have on the indications for treatment of acute cholecystitis.

Stone and Owings presented an excellent historical review of the subject, in which the advisability of both delayed and early surgical treatment was discussed. More recent contributions include the work of Heuer, McCloskey and Lehman, Fallis and McClure, Fowler, Atlee and Atlee, Edwards and associates, Best, Wallace and Allen, McNealy and others.

SELECTION OF CASES

The present study was limited to cases in which cholecystitis was considered to be acute preoperatively, surgically and pathologically. All cases in which cholecystitis was believed to be either subacute or chronic by the internist, surgeon or pathologist were excluded. We agree with Fallis and McClure that only by restricting cases in such a manner can a true picture of acute cholecystitis, from a clinical point of view, be obtained. The frequent lack of correlation between the pathologic process and the clinical evidence in cases of acute cholecystitis is well known. For example, from July, 1936, to April, 1942, there were found to be recorded 248 cases in which the diagnosis of acute cholecystitis had been made by pathologists (89 per cent of which were also believed by the surgeon to be acute cholecystitis); but none of these had been considered to be acute cholecystitis preoperatively. The mortality rate in this group was 2.8 per cent. By way of contrast, in the present study the condition of 127 patients who had acute cholecystitis treated surgically had been diagnosed as acute cholecystitis preoperatively, surgically and pathologically, with a mortality rate of 6.2 per cent. It is, therefore, at once apparent how confusing various data become unless a uniform classification of acute cholecystitis is employed by all authors.

For the purpose of evaluating the change in the pathologic process of acute cholecystitis in accordance with the duration of the disease, records of the symptoms of these 127 patients were divided into three main groups, namely, *immediate*, *early* and *delayed*, depending upon the interval between the onset of symptoms and the performance of an operation. The *immediate* group was composed of symptoms of patients on whom operation was performed within seventy-two hours from the onset of symptoms. Thirty-two cases (25 per cent) are included in this group. Symptoms that had persisted for from four to seven days before surgical treatment was undertaken were placed in the *early* group. There were twenty-seven cases (21 per cent) in this group. The remaining sixty-eight patients (54 per cent) had experienced symptoms for more than a week prior to

operation; their symptoms were placed in the *delayed* group.

PATHOLOGIC CHANGES IN RELATIONSHIP TO DURATION OF THE DISEASE

As is well known, there is a gradual progression in the inflammatory process in acute cholecystitis as evidenced by the histologic appearance of gangrene and gross evidence of perforation, as the acute process continues day by day. In the

TABLE I
RELATIONSHIP OF DURATION OF DISEASE TO INCIDENCE OF GANGRENE AND PERFORATION

Time of Operation	Acute Cholecystitis, Cases	Gangrene of Gallbladder, Microscopic Evidence		Perforation of Gallbladder, Surgical Evidence	
		No.	Per Cent	No.	Per Cent
Immediate	32	9	28.1	2	6.2
Early	27	8	29.6	3	11.1
Delayed	68	28	41.1	17	25.0
Total	127	45	35.4	22	17.3

delayed group, 25 per cent of the sixty-eight patients had evidence of local perforation, whereas, only 6.2 per cent of the thirty-two patients in the *immediate* group had such perforation. (Table 1.) It is therefore evident, as had been known previously, that certain advanced conditions such as gangrene and perforation can be avoided frequently by operation within the first few days after the onset of the symptoms of acute cholecystitis. In the entire group of 127 cases, twenty-two gallbladders were found to be perforated at the time of operation. Since the process of perforation usually is gradual enough to permit localization of the inflammatory reaction, generalized peritonitis resulting therefrom is not frequent. There were only two cases in which generalized peritonitis occurred in our series, and in both of these the symptoms were of the *delayed* group. It seems likely that peritonitis had been present for some time prior to operation in these two cases. It is also observed (Table 1) that the longer operation is delayed after the onset of symptoms, the greater the incidence of microscopic evidence of gangrene of the gallbladder will be. It would seem advisable when possible to avoid late complications of this type by prompt operation.

HEPATITIS AND PANCREATITIS

Hepatitis and pancreatitis commonly are associated with disease of the biliary tract, and a search for evidence of the presence of these conditions was made at the time of surgical exploration in this series of 127 cases. These two diseases were found to be present in more than 16 per cent of the sixty-eight cases in which operation had been deferred for more than a week; whereas, less than 10 per cent of the thirty-two patients operated upon within a week of the onset of symptoms had hepatitis and pancreatitis. (Table II.) The clinical importance of these two conditions may vary considerably from case to case. In certain instances one or both of them may be a predominant factor or factors in the patient's illness, but in many instances they are of no great clinical importance.

TABLE II
RELATIONSHIP OF DURATION OF DISEASE TO INCIDENCE OF PANCREATITIS AND HEPATITIS

Time of Operation	Cases, No.	Associated Hepatitis and Pancreatitis	
		No.	Per Cent
Immediate	32	3	9.3
Early	27	2	7.4
Delayed	68	11	16.1
Total	127	16	12.5

EASE OF OPERABILITY

The ease with which any operative procedure can be performed is a matter of some importance. In general, operations on the biliary tract which present no particular difficulties probably are associated with a lowered initial risk and an increased probability of an entirely satisfactory ultimate result. This is especially true of operations for acute cholecystitis. If cholecystectomy is especially difficult, the incidence of cholecystostomy may be increased, and although in some cases this operation may be definitely indicated, complete removal of the gallbladder generally is desirable if it can be performed without too great a risk. For this reason the ease of operation in the presence of acute cholecystitis is of some importance. Cholecystectomy usually is readily accomplished when it is performed within the first three days after the onset of the patient's symptoms. If operation is delayed for a longer period, the percentage of cases in which cholecystectomy is performed becomes definitely lower and more patients must be treated by cholecystostomy. (Table III.) There were eight deaths in the entire series of cases, resulting in a mortality rate of 6.2 per cent. (Table IV.) Two of the three patients with symptoms in the *immediate* and *early* groups who succumbed had been considered preoperatively to be exceedingly poor risks.

TABLE III

RELATIONSHIP OF DURATION OF DISEASE TO TYPE OF OPERATION PERFORMED

Time of Operation	Acute Cholecystitis, Cases	Operation, Type							
		Cholecystectomy		Cholecystostomy		Partial Removal Gallbladder		Drainage of Abscess	
		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Immediate	32	26	81.2	5	15.6	1	3.1		
Early	27	14	51.8	13	48.1				
Delayed	68	42	61.7	22	32.3	2	2.9	2	2.9
Total	127	82	64.0	40	31.4	3	2.3	2	1.6

TABLE IV

RELATIONSHIP OF DURATION OF DISEASE TO MORTALITY RATE

Time of Operation	Cases, No.	Deaths	Mortality Rate, Per Cent
Immediate	32	2	6.2
Early	27	1	3.7
Delayed	68	5	7.3
Total	127	8	6.2

COMMENT

The number of cases in the present series is too small to be of statistical value; however, experience based on this group of cases tends to indicate that the mortality rate and the incidence of postoperative complications with reference to the biliary tract are higher when surgical operation is done for acute cholecystitis than they are when it is performed for chronic cholecystitis. In six of the 127 cases reviewed herein there was some type of postoperative complication referable to the region of the gallbladder, such as cholangeitis, persistent drainage of bile or subsequent evidence of stone in the common bile duct. However, in a separate series of 127 con-

secutive cases in which operation had been performed for chronic cholecystitis during the early part of 1941, only one patient had any such complication, and there were no deaths in the series. The number of patients who might succumb from acute cholecystitis or its complications while under continued medical management for this disease cannot be readily determined. There would of course be considerable variation in statistical reports of such cases, depending upon the type of case included in the study.

If operation is to be performed for acute cholecystitis, it would seem preferable to perform it within the first seventy-two hours after the onset of the disease. Otherwise, the incidence of pancreatitis, hepatitis and extensive inflammatory reaction in the biliary tract and surrounding tissues renders operation more hazardous and more difficult and increases the likelihood of undesirable postoperative sequelae. If operation is not performed within this period, it would appear desirable if possible to postpone it until the acute process has largely subsided—usually a matter of three weeks or more. Indications for treatment should of course be decided for each patient.

SUMMARY AND CONCLUSIONS

Records of 127 patients who had cholecystitis which was diagnosed as acute by the internist, surgeon and pathologist, encountered from July, 1936, to April, 1942, have been reviewed.

It was observed that the incidence of gangrene and perforation increased as the duration of the disease increased. The same was true for the incidence of associated hepatitis and pancreatitis. The feasibility of performance of cholecystectomy in contrast to the feasibility of performance of cholecystostomy was greater within the first seventy-two hours after the onset of acute cholecystitis than at any subsequent time prior to subsidence of the acute process. Various complicating features associated with the surgical treatment of cholecystitis are more likely to occur when operation is performed for acute cholecystitis than when operation is performed for chronic cholecystitis.

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FIVE YEARS' EXPERIENCE WITH HEMO-IRRADIATION ACCORDING TO THE KNOTT TECHNIC

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IN May, 1940, the author published a report[20] on this method in 110 cases which he had treated in a period of about eighteen months. The material represented twenty-nine different conditions. Since that time other investigators have published a number of papers on the subject, the total, with the present paper amounting to fourteen. The writer has treated over 400 persons with this method during the last five years, and the present article sets forth some of the interesting findings which he and other workers have observed in connection with this radical departure from conventional methods of ultraviolet therapy. Nine illustrative cases are presented.

A comparison with the older methods is natural and inevitable. The ultraviolet radiologist has long recognized the difficulties attending the administration of this form of radiant energy arising from the great variability in important factors. The skin, it is hardly necessary to point out, offers a considerable problem by virtue of the variations met with, such as thickness, natural color and pigmentation, degrees of hematization, etc. In addition to these factors there are the inherent faults of the skin as a receptor for ultraviolet radiation, as for example the variation in sensitivity and its susceptibility to radiation injury. Notwithstanding these natural handicaps which interfere with efforts to utilize the skin as a medium for the absorption of ultraviolet energy, much has been accomplished in using it in the therapy of numerous conditions.

Some of the achievements of ultraviolet ray therapy in infections prior to hemo-irradiation are: *Lupus vulgaris*, a tuberculous disease of the skin and membranes was first successfully treated by Neils Finsen[4] with a special arc lamp of his design as long ago as 1897. Up to the year 1910, at the Finsen Institute in Copenhagen, Finsen and his successors had treated 2,000 patients with a recovery of 98 per cent. We still have lupus vulgaris with us. The author saw a case recently in which the greater part of the skin of the face was covered with the lesions; one eye had been invaded, the sight destroyed and the lids of the other were involved. Strangely, no one had used the Finsen technic or even a modification of it.

Extrapulmonary tuberculosis or surgical tuberculosis of bones, joints, peritoneum, etc., is another field in which ultraviolet radiation is pre-eminent. Dr. Cecil Rowntree,[33] Hunterian Professor of Surgery, Royal College of Surgeons, asserts, "The treatment of tuberculous disease of the bones has fortunately undergone a revolution in recent years for the drastic and crippling operations are now replaced by a regime which includes complete rest of the affected part and very conservative and limited surgical operation for the purpose of evacuating abscesses combined with sunlight treatment, real or artificial. When persevered with, such methods almost always effect a cure in every case."

Erysipelas. A few physicians employed ultraviolet radiation for this condition in the 1920's with success and Walter H. Ude, Radiologist to the Minneapolis General Hospital, reported a series of 100 cases in 1929, claiming for ultraviolet energy practically specific action in his series. This was substantiated by an increasing number of observers and the agent came into general

use during the next decade. It has been largely eclipsed by the introduction of the sulfa drugs which are easier to administer.

These examples of the effectiveness of ultraviolet radiation therapy—in the hands of competent therapists—are cited to give some indication of the potency of this form of radiant energy. The same kind of spectral energy is employed in the Knott technic, in a very different manner, however, from conventional methods.

With the Knott technic there is very little variability in the important factors involved. A definite amount of blood is removed from a vein, citrated and immediately returned to the blood stream via the Knott hemo-irradiator which consists essentially of a pump, an ingeniously designed irradiation chamber, a water-cooled mercury quartz lamp and a mechanism for controlling the rate of flow of the blood through the circuit and consequently the irradiation time. Accurate dosage, the one outstanding factor in the effectiveness of ultraviolet radiation therapy, is finally achieved in this manner. There had been much reason to believe before Knott's work that the most important element concerned in ultraviolet radiation therapy was the blood; but a practical and efficient direct method had not been devised, as far as the author is aware, until Knott and his associates evolved the method of treating the blood that is proving so valuable in the treatment of infections and other conditions.

One of the most celebrated authorities on immunology, Sir Almroth Wright,[9] (originator of the system of therapeutic innoculation for bacterial infection and of methods for measuring the protective substances in the blood) in his article on Immunology in the fourteenth edition of the Encyclopedia Britannica states as follows, "As has been shown in the irradiation of the skin with ultra-violet light, the light of the electric arc and sunlight that by these agencies also the bactericidal power of the blood is increased, such bactericidal power depending upon the increased phagocytic power of the leucocytes and also upon the increased antibacterial power of the serum. It is not yet known how irradiation produces these results. Increased bactericidal power is achieved only with certain quanta of irradiation and the blood suffers deterioration when larger doses are employed."

Other recognized authorities have similarly expressed themselves as for example Sir Henry Gauvain,[12] Sir Leonard Hill,[10] Sir Walter S. Lazarus Barlow[11] et al.[13]

There has been a good deal of investigation into the effect of ultraviolet energy on various constituents of the blood, normal and abnormal (bacteria, toxins, etc.). Other writers on hemo-irradiation have given some of the important references in their bibliographies.

To those bacteriologists and others whose experience with ultraviolet energy has been largely confined to experiments consisting in the exposure of petrie dish cultures to various sources of ultraviolet radiation and to *x*-rays, it is only fair to point out something that has apparently escaped many such an investigator, namely, the vast difference between inert gelatine and living reacting animal tissues.

The problem presented by the Knott technic is this: Granted for sake of argument that bacteria are readily killed under certain conditions by ultraviolet energy, granted also that they are killed if present in the blood of a patient when some of this blood passes through the irradiation chamber, and that toxins are inactivated also,[16,17,18] how is one to explain the apparent effects on the balance of the blood not treated ($^{15}\!/_{16}$ to $^{19}\!/_{20}$ of the blood volume)? It has been suggested that the irradiated portion carries the primary ultraviolet rays into the untreated portion of the blood and that secondary radiation is produced in this; but the author cannot entertain this theory from the point of view of the radiologist with any great enthusiasm. The initiation of chain photochemical reactions in the irradiated blood continued and in the unirradiated portion is probably the basis of the action. When we consider first of all

the complexity of even the most simple photochemical processes and then reflect on the very complicated character of blood consisting as it does of serum, red and white cells, platelets, chylomicrons, antigens and antibodies, hormones, endocrine substances, enzymes, iron, phosphorus, calcium, and various pathogenic substances at times, bacteria, bacterial and other toxins, etc., it seems somewhat fool-hardy to undertake to say just what happens under the influence of ultraviolet radiation although it may be said in truth that some things are known and we have clues about others.

PHYSIOLOGICAL EFFECTS FOLLOWING HEMO-IRRADIATION IN INFECTIONS AND TOXEMIAS

1. *Reduction in Toxemia.*[5] (Cases I–X.) This is demonstrated subjectively by improvement in the mental state and clarity of thinking and speaking which may take place within a few minutes following hemo-irradiation. By the following day reduction in toxemia is usually very noticeable, associated with an improvement in the sense of well being. Objectively, it is indicated by fall in temperature, diminution in the sedimentation time and improvement in the blood picture.

2. *Improvement in the Blood Picture.* There is a marked tendency for a restoration to normal levels of the various blood elements. With the reduction in the infective process there is a fall in the white count, with an increase in the young white cells. If the count has been low, due to poor response to the infection, it is frequently raised to an appropriate level for the severity of the infection. When leucopenia has been caused by certain drugs this is nearly always corrected. In the case of a secondary anemia, due to the two influences, destruction of red cells and inhibition of the red cell forming mechanism, there is a return to normal levels within a relatively short time. It will be noticed that some of the patients have received blood transfusions which may in some cases give a temporary boost to the red cells; but if the infection continues, this gain may be only transient. With a reduction of the toxemia following one or more hemo-irradiations, it is only natural that the blood picture should improve. That is one of the most consistent effects, and it is seen also uniformly in the less severe infections and in debilitated persons. The same effect is witnessed in the case of the hemoglobin. It is highly desirable to give patients blood transfusions and glucose when the blood is in serious condition and a prompt effect is imperative. There is no objection to transfusions and the records show that we have supplemented hemo-irradiation with these on numerous occasions. Every aid in desperate cases should be employed, but what we do wish to emphasize is the fact that many of our seriously ill patients have already had one or more transfusions (Case IV had seven), and these and other measures failing, hemo-irradiation was resorted to.

3. *Improvement in the Peripheral Circulation.* We have witnessed a great many times in cyanotic individuals a return to natural color even during the giving of the hemo-irradiation. In the case of the young woman with bronchopneumonia (Case VI) this was evident while she was still in the oxygen tent and receiving oxygen which was being given almost constantly, long before hemo-irradiation was contemplated. This change in color is due to an increase in the venous oxygen.[22] The improvement in the temperature of the extremities and the sense of warmth that patients remark about is a very common effect associated with hemo-irradiation. Patients volunteer this information, and the improvement in the circulation in the hands and feet is maintained indefinitely. In some cases it may last for only a few days to be restored after a second irradiation, or it may persist for months or longer.

4. *Relief of Pain.* One of the most interesting effects is early relief of pain. This may take place even while the treatment, which takes only seven to twelve

minutes, is in progress. At first the author believed that it was a psychological effect but it has occurred so many times, that is, the practically immediate relief, that it can no longer be explained on this basis. Within twenty-four hours relief is very common.

5. *Improvement in the Appetite.* (Cases II, V, VIII.) This is frequently a striking effect. There is cessation of nausea and a return of appetite taking place sometimes in twelve to twenty-four hours. This is commonly associated with a return to normal weight. Several of the cases described indicate the marked effect on the appetite and weight. The case of peritonitis (Case V) had a real zest for food in twelve hours. She gained fifteen pounds in fourteen days and twenty-six pounds in twenty-one. The patient with toxemia and debility (Case II) following eclampsia gained thirty-six pounds in seven weeks. The patient with superior inferior cerebellar artery thrombosis (Case IX) was forty-five pounds under normal weight when first seen and irradiated. He began immediately to gain, recovered forty-five pounds in about four months, and continued to gain so that in nine months he had put on fifty-five pounds.

Best results are obtained in infections in which the blood supply is good or moderately good, that is, in which the infection is not walled off to such an extent that the irradiated blood cannot enter the focus, as for instance in the case of an abscessed tooth. Toxemia and arthritis due to an abscessed tooth will be temporarily reduced, but in due course they will return if the tooth is not removed. It is desirable when several teeth are infected to irradiate the patient before extraction (Case VIII), and this can then be done safely at one time without fear of aggravating an associated arthritis or of producing a bacteremia. Healing of the sockets and gums is increased in rate if hemo-irradiation is given before or shortly after extraction.

Attention is called to the findings of Dr. E. W. Rebbeck in septic abortions.[30] He found that preoperative hemo-irradiation diminished postoperative temperatures, and in none of the cases in which operation was done after hemo-irradiation did a transient bacteremia develop, but in some cases in which a dilatation and curettage were done without preoperative irradiation transient bacteremias did appear.

In peritonitis in which the blood circulation is good and in cellulitis the results are excellent. It is desirable, of course, to remove a focus of infection or drain surgically. We always urge that, but to repeat, it is a very excellent practice to give preoperative hemo-irradiation especially in severe cases of infection to insure a good postoperative convalescence with a minimum of discomfort and to prevent complications.

RESULTS OF HEMO-IRRADIATION IN INFECTIONS

1. E. K. Knott and V. K. Hancock reported the recovery of two apparently moribund patients in 1934, one a septicemia and the other a brain abscess.

2. H. A. Barrett reported 110 cases in 1940, including a number of infections. Twenty-nine different conditions are represented in this series. Among the conditions treated were the following: infectious arthritis, thirteen cases; osteo-arthritis, sixteen; tuberculosis glands, two; chronic blepharitis, four; mastoiditis, two; uveitis, one; furunculosis, three; chronic paranasal sinusitis, four; acne vulgaris, three; secondary anemias, eight. The results were very encouraging.

3. In a series of 151 consecutive unselected cases of acute pyogenic infections treated by George Miley at Hahnemann Hospital, Philadelphia, between November 1, 1938 and December 31, 1941, the recovery rate was 100 per cent in the early cases; in the moderately advanced eighty-one cases the rate was 98 per cent and in fifty-five apparently moribund patients the rate was 42 per cent. The series included eighteen cases of puerperal sepsis with eighteen recoveries; septic abortions, nineteen cases with seventeen recoveries; gen-

eralized peritonitis, seven cases with seven recoveries; four femoral thrombophlebitis cases with four recoveries, and seven pelvic abscess with pelvic peritonitis cases with seven recoveries. Of the 151 cases, fifty-seven were obvious chemotherapeutic failures. In the fifty-five apparently moribund patients there were twenty-six who received combined hemo-irradiation, and of these nine had bacterial endocarditis and seven had Staphylococcus aureus septicemia. If all the cases of bacterial endocarditis and Staphylococcus aureus septicemia are excluded, there are a total of thirty-one recoveries among forty-one cases of obvious chemotherapeutic failure which is about 75 per cent.

4. E. W. Rebbeck reported on ultra-irradiation of blood in the treatment of puerperal sepsis. Between July, 1937, and May, 1940, thirteen patients were treated with hemo-irradiation all of which recovered. There were six sulfa drug failures in this group. One patient showed non-hemolytic streptococcic positive blood cultures. All patients with puerperal sepsis now receive hemo-irradiation at Shadyside Hospital.

5. E. W. Rebbeck also reported on septic abortions. From July, 1938, to June, 1941, sixteen patients were treated in Shadyside Hospital, Pittsburgh, twelve preoperatively and four postoperatively. Of these seven were in a state of advanced morbidity when admitted and one had an indifferent streptococcus in the blood stream. In those instances in which this therapy was used postoperatively (in four cases with advanced morbidity) prompt relief of toxemia and decrease in fever were outstanding. Three patients had been given sulfanilamide. All the patients recovered.

6. Virgil K. Hancock reported four cases of hemolytic streptococcus blood stream infections, one colon blood stream with a temperature of 108.4°F. and a Staphylococcus albus blood stream infection complicated by osteomyelitis and bronchopneumonia. These patients were treated between 1933 and 1938. The total number of treatments was seventeen or an average of 2¾. He reported in the same paper five cases of Streptococcus viridans infection of the blood stream, three patients with endocarditis, all dying, and two without endocarditis who recovered.

7. Miley reported thirteen consecutive cases of acute thrombophlebitis with thirteen recoveries. In all thirteen cases a rapid disappearance of pain and tenderness was observed, usually within twenty-four to forty-eight hours. Five of the cases were chemotherapy failures. Edema subsided in twelve cases, the disappearance time varying from three to fifteen days. Local heat and bed-rest elevation of the extremity had been tried without success in a number of cases.

CASE REPORTS

Case 1. Infectious arthritis with uncontrollable perspiring. Physician, Dr. Hunter, Flushing, N. Y.

The patient had rheumatic fever in 1933 which left her joints so painful she could scarcely walk, for a month or so. Then she seemed to recover completely except for her heart which was temporarily affected but she seemed to recover from this after a time.

However, during the winter of 1937 to 1938 she developed a myocarditis and endocarditis. She had very severe night sweats and her weight fell off considerably to seventy pounds. A month before coming to me for an irradiation she had had a tooth extracted and a culture showed Streptococcus hemolyticus.

At the time of hemo-irradiation the patient looked weak and ill. She had been sent to me to see if irradiations would have any effect on the uncontrolled night sweats. She had been under several physicians for this, but no definite cause was found and all medication failed. The patient stated that she had to remove or change the bed linen three and four times nightly summer and winter. She had in addition to this polyarthritis which was moderately severe, but it was because of the sweating she had come to the author.

The patient was given five irradiations in all. The first treatment was given on a Saturday, June 24, 1938. On Sunday morning the patient phoned to say that she had perspired only about half the usual amount and that she felt

better. The perspiring diminished still more the following night and became progressively less. When she came for her second irradiation for a period of three months, her health was in a wretched state. She was weak, lacked an appetite, and could not regain her lost weight,

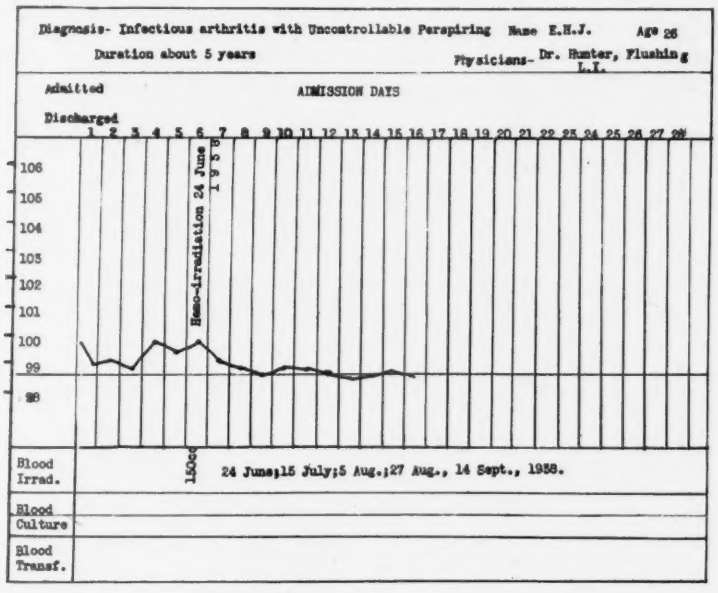

FIG. 1. Case I.

on the 15th of July, she was generally much improved, although the sweating was increasing somewhat. The second and subsequent irradiations were very effective, and following the third she was completely over her sweating and it never returned.

The patient was heard from through her husband for several months after her last treatment, and there has been no return either of the perspiring or of the arthritis.

CASE II. Toxemia of pregnancy and post-eclampsia.

A white female, aged twenty-three, became pregnant about November 15, 1937. Shortly after this she developed nausea and vomiting, and for about three weeks she could barely keep anything but water and fruit juices on her stomach. She lost about twenty-four pounds in weight in a period of about six weeks. She was very weak and her skin was covered with a great number of small pimples. She then started to improve, but at no time did she feel like herself. At six and one-half months she had a sudden eclamptic seizure after complaining of a headache the morning of the attack. At the hospital she was placed on the Stroganoff sedation therapy to which she responded fairly well. However, in a week's time the fetal heart sounds ceased and the fetus was removed. Following her return home, her weight being only one hundred six (normal one hundred twenty-eight). It was decided to give her a hemo-irradiation and this was followed by a remarkable improvement in her health. She gained thirty-six pounds in seven weeks.

After an interval of two years, she became pregnant a second time, but again she became very toxic and started to lose weight quickly. An irradiation was given with a very prompt improvement in her health and strength. Another irradiation was given in ten days followed by a third in ten days. She was given a prophylactic hemo-irradiation seven days and another seven hours before being delivered of a healthy child. A few weeks ago she became pregnant for a third time, and soon after started vomiting and appeared to be about to have a repetition of previous toxemias. This time hemo-irradiation was given at once followed by a second in two weeks, and at the present time she enjoys much better health than in the earlier weeks of her previous pregnancies. She is maintaining her weight and has no signs of nausea or evidence of toxemia.

Various writers have reported on the value of ultraviolet radiation in the toxemias of pregnancy and in pre-eclamptic states. Hochenbichler treated 100 patients

in which there was acidosis by ultraviolet radiation and even after the onset of convulsions and treated in the early stages

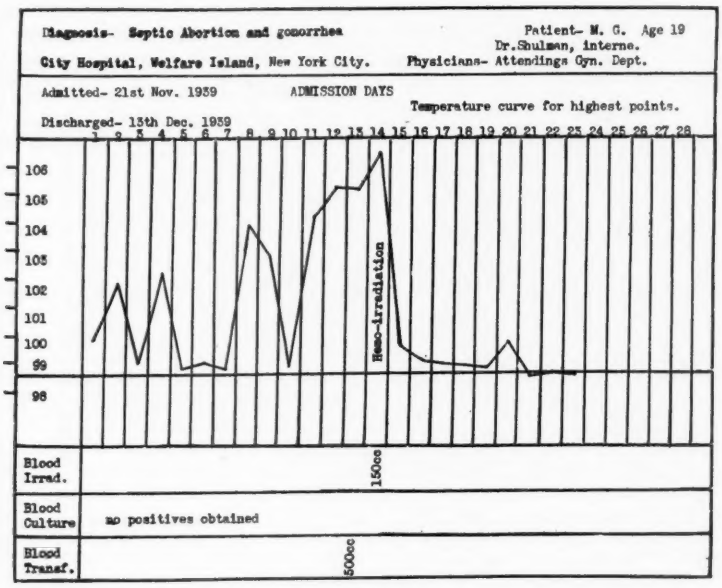

FIG. 2. Case III.

none developed serious complications. In Case II, there is no question of the marked benefit to the health following irradiations on three separate occasions associated with three pregnancies, in the same individual. No claim is made for hemo-irradiation for toxemias of pregnancy on the basis of this one case, but the author believes the method deserves further investigation in this class of toxemias.

CASE III. Abortion followed by sepsis.* Chemotherapy failure.

A nineteen year old white female was admitted for vaginal bleeding on November 21, 1939. She stated that in February, 1939, she was delivered of a seven month's living premature infant by forceps. Her first menstrual period returned on October 12th and lasted one and one-half days. Following that period she thought she was pregnant, so she pushed her finger into her uterus on November 12th and began bleeding with passage of clots. She continued bleeding until admission. On the morning of admission she had a chill. She appeared acutely ill. Her temperature was 100°F., pulse 104, respirations 24.

* History of case taken from hospital records of City Hospital, Welfare Island.

Examination revealed a pinkish purulent discharge in the vagina originating from the endocervix. The cervix was slightly soft, not patulous. It was retrodisplaced, normal in size, the adnexa was not outlined but there was a sensation of masses in both regions. Her temperature ranged between 99 and 102.6°F. for the first two days. Cervical and urethral smears were positive for gonococcus and the patient was placed on sulfanilamide on November 25th. Her temperature remained at 99°F. for three days but on November 28th after she had received 180 gr. of sulfanilamide she became cyanotic and had a chill with a temperature of 103.6°F., so this drug was discontinued. The patient then began running a septic temperature up to 105.6°F. Seventy gr. of sulfanilamide were given on December 2nd and again discontinued.

On December 3rd the patient was given a 500 cc. blood transfusion. Her temperature on December 4th at 2:30 P.M. was 106.4°F. following a chill. All blood cultures were negative.

Hemo-irradiation was ordered and 130 cc. of the patient's blood was irradiated and reinjected. The temperature fell by crisis on the following day and remained normal except for a rise to 100°F. on December 10th which promptly returned to normal. A catherized urine examination on December 28th was negative. Constant blood studies were made and on discharge, all studies were found normal.

CASE IV. Septic abortion with pelvic abscess and peritonitis. Chemotherapy failure.*

M. L., a twenty-nine year old white female was admitted on October 16th with the following history: Her last menstrual period was on July 26th. Two weeks prior to admission she took twelve ergot pills followed by mustard baths. The following day she began to bleed vaginally passing foul smelling blood clots. Bleeding and passage of clots continued. Two days before admission she had chills, fever, malaise and weakness of arms and legs. The patient was a para III, grava V. She had a seven-months fetus which died at birth. Her menstrual history, past history and system review were negative.

Physical examination on admission revealed an acutely ill patient. Her temperature was 100°F., pulse 112, respirations 24, blood pressure 112/76. The abdomen was soft with tenderness in both parametrial regions. Pelvic examination revealed the vagina to be filled with blood clots and placental tissue; the uterus was enlarged to the size of a three month's pregnancy; it was soft and boggy; the cervix was soft and admitted the tip of finger; the adnexa was tender bilaterally and a brawny mass was attached to the left side of the uterus. The patient had a swollen, tense and tender right olecranon and knee. A diagnosis of septic incomplete abortion was made. A D and C was done on October 18th and about 2 ounces of necrotic foul endometrium was obtained. The patient was put on sulfanilamide on admission. Following curettage the temperature became septic, striking between 101 and 104°F. Transfusions were given. The joint complaints had subsided by October 28th, but the temperature continued septic. Examination on October 31st revealed an extremely tender soft mass to the right of the uterus. On November 4th examination showed abscess of the right broad ligament. The patient was taken to surgery and a colpotomy done. About ½ ounce of frank pus and some cheesy material was discharged. A large tube was inserted for drainage. The temperature peak was 103°F.

On November 5th, 190 cc. of patient's blood was irradiated and re-injected. On the following day the temperature dropped to 101°F. and for the next few days it ranged between 99 to 100°F. On November 11th examination revealed a large tender mass in the left lower quadrant and the temperature rose to 101°F.; 150 cc. of patient's blood was again irradiated and reinjected. Her temperature began falling slightly but on November 13th a transfusion was given and the patient had a reaction with temperature rising to 105°F. Blood cultures were negative but on delayed growth was called Bacillus coli. The day following the transfusion reaction, the patient became jaundiced with an icteric index of 55. On November 17th the icterus began to subside and temperature became lower—between 99 to 102°F. On November 24th the colpotomy tube was removed, temperature began to flatten out and by November 27th it reached normal and remained so. However, examination on November 25th revealed the large tender mass in the left side extending almost to the level of umbilicus. By December 2nd the left adnexal mass had decreased some in size and tenderness.

Examination on December 12th revealed the right adnexal thickened, the uterus pulled to the right, normal in size, and a tender cystic mass in front and to the left of the uterus. The last examination made on December 16th revealed findings as above but the mass had decreased in size to three fingers above the symphysis on the left and a diagnosis of subsiding postabortal salpingitis was made. Catheterized urine examinations had been negative throughout. Hematological examination on admission showed 70 per cent hemoglobin and 23,000 white blood cells. Hemoglobin never fell below 60 per cent and a complete blood count on November 24th revealed 4.14 red blood cells with 72 per cent hemoglobin, totaling 2,950 cc. of citrated whole blood. Electrocardiograms were normal. Pelvic diathermy begun on November 30th was continued for ten days. The patient was discharged well. Follow-up clinic records show that the patient recovered from all intrapelvic disturbances, the uterus was free and moveable and there were no masses in the adnexae.

CASE V. Peritonitis due to nonhemolytic staphylococcus aureus. (Patient of Dr. E. D. 140 E. 54th Street, N. Y. C.) E. M. Chemotherapy failure.

E. M., was admitted on September 19, 1941 because of pain on defecation, metrorrhagia and tender pelvic mass. She had been operated upon in 1938 for ruptured appendix but had been in bad health ever since. Operative find-

*History of case taken from hospital records, City Hospital, Welfare Island.

ings were bilateral pyosalpinx with cystic degeneration of the right ovary, myoma uteri and chronic pelvic peritonitis. The patient did well until the fourteenth postoperative day when she developed pain in the pelvis and started to run a temperature. Diagnosis of pelvic abscess was made and sulfathiazole was started, but discontinued the next day because of cyanosis. Ten days later a large abscess cavity containing 300 cc. of white nonodorous pus was evacuated from the region of an old appendix stump. Sulfathiazole was started again and the patient apparently tolerated it well this time. But on September 20th the temperature was still up to 105°F. and as there was a suspicion that this was due to the sulfathiazole a blood sulfa level was done which showed only a faint trace of the drug. The drug was discontinued but the temperature still continued. Two days later the patient was given a hemo-irradiation and in twenty-eight hours was well, headache was gone, temperature was normal, appetite was excellent, she had no aches or pains and the draining sinuses healed and closed rapidly. The patient put on fifteen pounds in fourteen days, twenty-six pounds in twenty-one and thirty pounds in sixty days. She has remained in excellent health for the last one and one-half years.

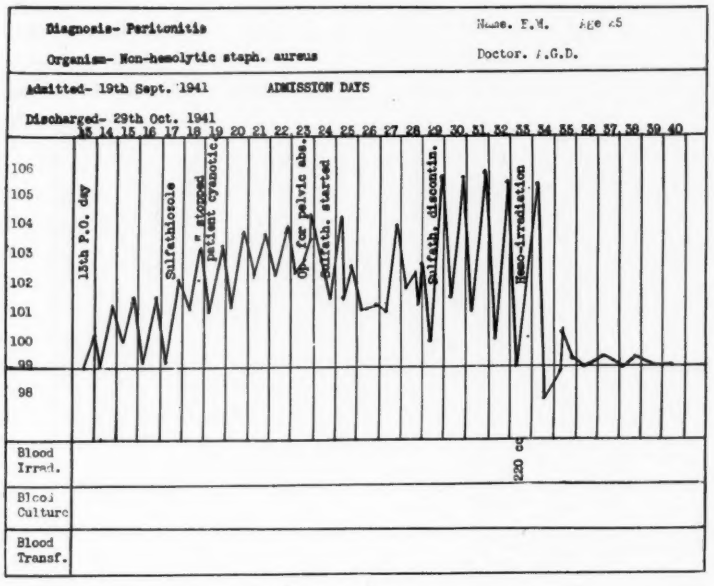

Fig. 3. Case v.

Case vi. Bronchopneumonia; chemotherapy failure.

I was called to treat a twenty-five year old female, a relative of a physician, suffering from bronchopneumonia. She had been taken ill twelve days previously and when seen by me she was in an oxygen tent. Several films of the chest were examined and they disclosed the characteristic shadows of bronchopneumonia. The patient in spite of oxygen therapy was moderately cyanotic. She was not responding to sulfa drug therapy and her white cell count was 9,000 in spite of a severe infection. Her physician and three consultants regarded the case as hopeless, and hemo-irradiation was requested as a last resort. The temperature ranged from 99 to 102°F. but had been higher. However, due to lack of resistance as indicated by the low white count and the patient's general condition, her temperature had remained relatively low (99–101°F.) for several days prior to my first visit.

The usual dosage was employed in this case, and I requested that the oxygen be cut down considerably following the irradiation, for we have found that even before an irradiation is completed, the color usually improves due to greater oxygen absorption. It is no uncommon experience to see the patient with cyanosis become pink before the irradiation is completed. The following day this patient was receiving no oxygen. She was much stronger, and was sitting up. She convalesced satisfactorily, having received only one hemo-irradiation.

Case vii. Infectious arthritis with severe toxemia; chemotherapy failure.

A. K., a male chief tool and die maker for a naval ordnance plant, became ill about No-

vember 30, 1941, with severe pains and swelling in his left wrist. He was removed to a hospital where eighteen teeth were extracted. In spite of this, his wrist became more swollen and painful. He remained in the hospital for fourteen days during which time he lost sixteen pounds. His physician requested hemo-irradiation as he was gradually getting worse, and when treated by me on December 17th he was very toxic, his hand greatly swollen, was in a sling and he could bear no one to touch it. His sedimentation rate was 120 mm. in sixty minutes. Within an hour after the irradiation he could move his fingers and permit examination of the hand and wrist. The following day his appetite returned, he was obviously much less toxic and much stronger. He had a second irradiation on the 19th at which time his sedimentation rate had fallen to 60 mm. He returned to work on December 22nd, having gained seven pounds in six days, and has been well since.

Case VIII. Thrombosis of the superior inferior cerebellar artery, bronchopneumonia, pyemia, embolization of the lungs, left femoral thrombophlebitis, paralysis of the left side of body and left vocal cord.[21]

In January, 1940, the author was called to Miami to treat the brother-in-law of a New York physician for a severe toxemia. He had become ill with severe pains in his right shoulder accompanied by intermittent elevation of temperature. He was admitted to a local hospital where in a day or so a swelling appeared in the clavicular region, and soon extended to the right side of the neck. He developed pyemia with embolization of the lungs and bronchopneumonia. Flaccid paralysis of the left side of the face and paralysis of the left vocal cord developed. He coughed with great productivity, there was choking and food was vomited. He became delirious and irrational. When seen by me he had taken nothing but coca cola for eleven days. He had lost forty-five pounds in weight and was in an oxygen tent. His brother-in-law had employed autohemic therapy some days previously without response. I had the man transferred to the Miami Beach Hospital where hemo-irradiation was instituted. There was an immediate response to the first treatment, and a second was given in three days with more improvement. Returning to New York, I was called a second time to Miami, for there had been a slight elevation of temperature. Four days after this the patient was brought to New York and admitted to the Manhattan Eye, Ear and Throat Hospital and placed under the care of Dr. A. Cinelli. He remained there six weeks, when his improvement justified his removal to his home, where in the course of several months he made a complete recovery, and when last seen in December, 1941, he had gained back his lost forty-five pounds and had added ten more. He showed no sign of his serious illness.

The case is not presented in full for lack of space, but it is reported to draw attention to the practically hopeless condition of a patient suffering from what was discovered in New York to be a thrombosis of the superior inferior cerebellar artery with a number of severe complications. The hemo-irradiation was given in the hope of controling the marked toxemia—he had on a number of occasions a sediment rate of 120—and also to build up his resistance. During the hospitalization in New York, he developed a thrombosis of the femoral vein on the left side accompanied by rise of temperature and very severe pain. Various measures were used without avail, but after an irradiation there was a prompt response and this complication disappeared in two or three days. In all, this patient was given nine hemo-irradiations, three in Miami, three at the Manhattan Eye, Ear and Throat Hospital, and three after he returned home. During his convalescence at home, it was discovered that he had a toxic goiter which accounted for the continued elevation of the pulse rate. This condition was treated by radium with very satisfactory results.

Case IX. Staphylococcus pyogenes aureus blood stream infection and foot-drop following the administration of sulfametathiazol. Chemotherapy failure.

A white unmarried woman, aged twenty-eight, had a chill followed by fever on May 11, 1940. No cause was discovered but as her fever continued she was admitted by her physician, Dr. Carl Zoll, to Wickersham Hospital, New York, on May 14th. At this time she was not acutely ill and did not complain of headache or pain of any kind, only a feeling of malaise. Her temperature on admission was 102.6°F. Two days later a blood culture was reported positive for Staphylococcus aureus. She was placed on neo-prontosil and under this her temperature gradually fell. For reasons not disclosed by her hospital chart, she was dis-

charged from the hospital June 10th. Her temperature was about normal, but she had a positive culture the day of discharge and she also had a secondary anemia of moderate degree.

Two days later she was re-admitted with a temperature of 100.6°F. and the same day was given a 500 cc. blood transfusion, and prontosil was continued. Her temperature fluctuated between 97 and 99°F. and she had a number of negative cultures, but also three positives. On July 12th, it was decided to discontinue the neo-prontosil and try sulfamethathiazol, but the positive cultures continued and in a few days she developed foot-drop.

As the patient was making no real progress, the sulfa drugs having failed to clear up the blood stream infection and also because of the footdrop, sulfametathiazol was discontinued and Dr. Zoll requested me to give his patient an irradiation of her blood by means of the Knott technic. The amount of blood treated was 210 cc. Six days later a blood culture was returned positive. Meanwhile thiamin chloride was instituted for the foot-drop. A second hemo-irradiation was given eleven days later together with a blood transfusion of 300 cc. This was her third blood transfusion and her second hemo-irradiation. It is only fair to point out that the 3rd blood transfusion given with the second hemo-irradiation may have played a role in clearing up the secondary anemia, although the two previous blood transfusions had not been followed by any improvement.

Three hemo-irradiations were given after the patient left the hospital to prevent any possibility of relapse. The only medication received after the first hemo-irradiation was thiamin chloride for the foot-drop. This condition cleared up very rapidly under this therapy.

SUMMARY

The author in a five-year period (February 16, 1938 to February 16, 1943) has treated over 400 patients suffering from a variety of conditions, infections of various kinds, systemic and regional, including the eye. He has used the method in about thirty cases of asthma and in about sixty cases of arthritis, rheumatoid, infectious and osteoarthritis. In all about thirty-five different conditions have been treated.

Long before the Knott technic of hemo-irradiation was introduced, ultraviolet spectral energy had proved to be a therapeutic agent of preeminence in a variety of conditions: rickets, infantile tetany, extra-pulmonary tuberculosis, erysipelas, lupus vulgaris, various skin conditions, certain diseases of the eye (Duke-Elder[8]), et cetera.

By the Knott technic the scope of therapeutic usefulness of ultraviolet radiation has been considerably increased so as now to include bacteremias, toxemias, peritonitis, thrombophlebitis and other serious infective conditions in which the operator can now anticipate prompt and effective action even when sulfa drug therapy and ordinary transfusions fail.

It is a method which raises the general resistance of the individual, diminishes toxemia rapidly and stimulates the healing forces of the body.

It is a safe method with no untoward reactions. It can be used to supplement other recognized measures, operative and medical, but in its own right it is a measure which will often effect a cure when all other therapy has failed.

Nine illustrative cases are offered as evidence of the unusual therapeutic properties of this new method of employing ultraviolet radiant energy with precision apparatus which overcomes most of the uncontrollable factors which have hitherto made the administration of this energy uncertain even in the hands of skilled operators; and it makes possible the treatment of serious infections heretofore not amenable to conventional ultraviolet radiation therapy.

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PHLEGMONOUS CECITIS*

REPORT OF TWO CASES AND REVIEW OF THE LITERATURE

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INTRINSIC inflammatory disease of the large intestine resulting in a phlegmon is a relatively uncommon disease. It is the purpose of this paper to report two cases of phlegmonous cecitis and to review the literature. Although this condition is similar to phlegmonous inflammation of other parts of the gastrointestinal tract, it presents special problems because of its localization in the cecum. Phlegmonous inflammation of the cecum secondary to appendicitis or diverticulitis will be excluded from this paper.

HISTORY

Phlegmonous inflammation of the gastrointestinal tract was first mentioned by Galen who described its occurrence in the stomach. Finsterer[1] in his study of phlegmonous gastritis cited Sand who described the first authentic case of circumscribed phelgmon of the stomach in 1700, and the first case of diffuse phlegmon of the stomach discovered accidentally at autopsy by Andral in 1829.

In 1842, Rokitansky[2] described phlegmon of the small intestine which he named enteritis phlegmonosa. The first indisputable case of phlegmon of the large intestine was reported by Goldschmidt[3] in 1887.

DEFINITION

Phlegmonous cecitis is a suppurative inflammation of the cecal wall, beginning as a cellulitis of the submucosa, and terminating in a circumscribed or a diffuse inflammation.

ETIOLOGY

From the nature of the disease, it is reasonable to assume that phlegmonous cecitis is caused by bacterial infection. Bacteriological studies of this condition are very scant in the literature, but where they were carried out, the predominant organisms found were streptococci and staphylococci, alone, or in combination. Bacillus coli and pneumococci were also mentioned as causative agents. Ingier[4] and Leuchtenberger[5] each reported a case of pneumococcic sepsis with metastatic phlegmonous cecitis in which pneumococci were recovered from the wall of the cecum.

The portal of entry for the offending organism may be either enterogenous or hematogenous. The former is by far the more common way. There are certain etiological factors which permit enterogenous infection. Dowd[6] mentions superficial mucosal abrasions and Bsteh,[7] Cordes[8] and others believe that these may be caused by hard fecal masses. All these authors agree that these abrasions may allow entry of the infecting organisms. Sauer[9] and Szabó[10] report cases in which Trichocephalus dispar and Oxyuris vermicularis were found, and are of the opinion that these worms injured the intestinal mucosa sufficiently to permit entry of bacteria. Cecum mobile and consequent distention and venous stasis are thought by Köntzey and Jáki[11] to be contributory factors. Foreign bodies, such as fragments of bones and fruit stones may also abrade the mucosa in the opinion of Roman,[12] Pich,[13] and Hellström.[14]

The hematogenous mode of infection is mentioned in the literature by Bsteh, Ingier, Leuchtenberger, and Müller.[15]

PATHOLOGY

Phlegmonous cecitis may be divided into two types: the circumscribed phlegmon and the diffuse phlegmon. The circum-

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scribed phlegmon of the cecum is characterized by an irregularly oval or circular area of edema and redness, sharply differentiated from the surrounding normal tissue. The area is frequently covered with thin, grayish-yellow fibrin and feels doughy. Occasionally, there is central softening in the mass due to abscess formation or to ulceration of the mucosa. The peritoneal cavity is relatively free of reactive fluid in this type.

The diffuse phlegmon is characterized by marked edema of the entire cecum, and in contradistinction to the localized form, its borders merge imperceptibly into the normal ascending colon. The edema is more pronounced and the involved area is an angry purple-red. The fibrinous exudate is thicker, shaggier and more grayish in appearance. In this type there are numerous punctate hemorrhages throughout the involved area. On palpation, the diffuse phlegmon is of a firm rubbery consistency. In most of these cases there is a reactive peritonitis as evidenced by turbid fluid and widespread deposition of fibrin.

The microscopic picture is essentially the same in both types. This consists of a profuse exudation of a collagen-rich fluid in the submucosa and to a lesser extent in the subserosa. There is an infiltration of numerous polymorphonuclear leucocytes in both these areas; in the circumscribed type this infiltration frequently terminates in focal abscesses which may coalesce in the submucosa to form larger abscesses. The muscularis and the mucosa are involved in the process but to a much lesser degree. Occasionally, an ulcer of the mucosa may form due to the presence of abscesses in the submucosa which break through into the lumen of the gut.

In sections stained for bacteria, they have almost invariably been found in the submucosa. In the diffuse phlegmon, the entire wall of the cecum may participate equally in the disease.

The microscopic process always extends for a considerable distance further than is evidenced by the gross appearance. Bauer[16] has compared this type of inflammation and its spread to erysipelas.

The pathological process of phlegmonous cecitis has been frequently likened to that of appendicitis in the literature. Progression to gangrene and perforation is much more marked in appendicitis than in phlegmonous cecitis due to the scanty blood supply and the poor drainage of the appendix.

DIAGNOSIS

The difficulty of making a preoperative diagnosis in these cases has been stressed in the literature. Biedermann[17] states that even at operation in many cases the true nature of the condition cannot be ascertained. Fenkner,[18] however, believes that if this condition is kept in mind, the characteristic appearance of the lesion should permit the diagnosis to be made.

The symptomatology simulates that of acute appendicitis in most cases, being characterized by abdominal pain, fever and vomiting. There are cases of phlegmon of the cecum that closely simulate carcinoma because they present symptoms of obstruction and a mass. Other cases are difficult to differentiate from tuberculosis of the cecum.

The outstanding physical finding in phlegmon of the cecum is the presence of a mass in the cecal region. This mass is fixed or movable, depending upon the extent of the lesion, and is always tender, but the tenderness varies in degree. The above findings together with the history suggest appendiceal abscess.

From our study of the literature, it would appear that the very early appearance of a mass in the cecal region, e.g., within forty-eight hours, should aid in differentiating this condition from appendiceal abscess in some cases.

Those cases that simulate carcinoma or tuberculosis of the cecum can be differentiated only at exploratory laparotomy.

Occasionally, a case of regional enteritis may involve the cecum to such a degree

that it may simulate phlegmonous cecitis. Careful exploration will, in all cases, reveal involvement of the small intestine by the same process.

TABLE I
COLLECTED CASES OF PHLEGMONOUS CECITIS

Author	Cases	Age	Sex	Treatment	Result
Biedermann[17]	1	28	f	Ileocecal resection	Recovery
Bsteh[7]	2	22	m	Ileocecal resection	Recovery
		55	m	Exteriorization of cecum	Death
Bundshuh and Wolff[20]	1	31	f	Ileocecal resection	Recovery
Burke[19]	1	18	f	Appendectomy	Recovery
Cordes[8]	2	36	m	Resection of involved area	Recovery
		45	f	Ileocecal resection	Recovery
Fenkner[18]	7	?	?	6 appendectomies	Recovery
				1 excision	Recovery
Fenkner[18]	1	12	m	Ileocecal resection	Recovery
Häbler[21]	1	19	m	Partial cecal resection	Recovery
Jordan[22]	1	10	f	Excision of area	Recovery
Moll[23]	1	30	m	Ileocecal resection	Recovery
Møller[24]	2	32	f	Excision of area	Death
		26	m	Excision and appendectomy	Recovery
Nystrøm[25]	1	40	m	Excision and appendectomy	Recovery
Otto[16]	1	?	m	Appendectomy and secondary ileocecal resection	Recovery
Pich[13]	4	39	m	Appendectomy	Recovery
		26	m	Appendectomy and drainage	Recovery
		20	f	Appendectomy and drainage	Recovery
		30	f	Appendectomy and excision of inflammed area	Recovery
Reisinger[27]	2	?	m	Drainage	Recovery
		37	f	Drainage and partial resection of cecum	Death
Röpke[28]	1	16	m	Appendectomy	Recovery
Sarafoff[29]	1	49	m	Ileo-cecal resection	Recovery
Sonnenberg[30]	1	?	?	No information	Recovery
Szabó[10]	1	35	f	Ileocecal resection	Recovery
Teutschlaender and Valentin[31]	1	51	f	Ileocecal resection	Recovery
Thomas[32]	2	62	f	Appendectomy	Recovery
		?	?	Appendectomy	Recovery

Solitary ulcer of the cecum may produce a picture similar to that of phlegmonous cecitis, but is differentiated by the marked tendency to perforation in the former.

Very few hematological studies have been made in the reported cases in the literature, but in the early stages there is invariably a leucocytosis with a relative polynucleosis. In the more protracted cases there is a relative lymphocytosis.

TREATMENT

There is almost complete agreement as to the treatment of phlegmonous cecitis. It is believed that an exploratory laparotomy is indicated because of the difficulty in differentiating this condition from appendicitis. More than half of the cases in the literature have been subjected to an ileocecal resection. In some instances this was done because the lesion was not recognized at operation, and in others because the surgeon thought that the process would not subside with conservative therapy. In seventeen cases, appendectomy, with or without drainage, was done. All these patients recovered.

TABLE II
COLLECTED CASES OF PHLEGMONOUS COLITIS INVOLVING CECUM

Author	Extent of Lesion	Treatment	Result
Bohmansson[33]	Cecum and ascending colon	Appendectomy	Recovery
Ingier[4]	Cecum and ascending colon	No operation	Death
Köntzey and Jaki[11]	Cecum and ascending colon	Drainage	Death
Leuchtenberger[5]	Entire colon	No operation	Death
Moll[23]	Cecum and ascending colon	Ileocecal resection	Recovery
Orth[34]	Entire colon	No operation	Death
Pallin[35]	Cecum and ascending colon	Appendectomy and ileocecal resection	Recovery
von Saar[36]	Cecum and ascending colon	Ascending colon exteriorized; subsequent resection	Recovery
Sauer[9]	Cecum and ascending colon	Resection of cecum and ascending colon	Death
Szabó[10]	Cecum and ascending colon	Ileocecal resection	Recovery
Finsterer[1]	Cecum to middle of transverse colon	Resection of involved area	Recovery

If a correct diagnosis had been made, operation could have been avoided. Exteriorization of the involved area was the procedure used on one occasion. The methods of treatment utilized may be

seen by referring to the table summarizing the cases in the literature. (Table I.)

PROGNOSIS

The mortality of the cases reported in the literature, including our own, is 8 per cent. (Table I.) When the process is not limited to the cecum but extends to other parts of the large intestine, the prognosis is very grave, the mortality rate being 45.4 per cent. (Table II.)

REVIEW OF THE LITERATURE

A careful survey of the literature revealed that phlegmon of the cecum is a relatively uncommon disease. We were able to find thirty-five cases of phlegmon limited to the cecum and eleven cases of phlegmon of the colon in which the cecum participated in the pathological process. We excluded a case reported by Matthes in which there was a phlegmonous inflammation of the whole gastrointestinal tract from the esophagus to the rectum. For ease of presentation and visualization, the cases are summarized in two self explanatory tables. (Tables I and II.) It will be noted that Fenkner's cases are included in Table I although much essential data is missing. This was done because his description of phlegmon of the cecum was so characteristic that we believed he could be expected to determine with some degree of accuracy whether or not a particular case was one of phlegmonous cecitis.

ORIGINAL CASE REPORTS

We are presenting a summary of the hospital records of two cases of phlegmonous cecitis. These patients were admitted to Beth Israel Hospital on the service of Dr. P. Klingenstein.

B. P. No. 48811. June 7, 1932. The patient was a thirty-five year old white woman admitted to the hospital complaining of pain in the right lower quadrant. The onset of the present illness occurred suddenly ten days ago with griping, colicky pain limited to the right lower quadrant. There was concomitant loss of appetite and "dyspepsia." Fever was not noticed, nor was there vomiting or diarrhea. No urinary symptoms were present. Repeated enemas afforded no relief. Her past history was irrelevant except for a laparotomy following accident to "internal organs."

Examination revealed a well nourished woman who appeared acutely ill. Apart from the abdominal examination, there were no abnormal physical findings. A lower median abdominal scar was present. There was moderate distention and a firm mass could be felt in the right lower quadrant. This mass was fixed, extremely tender and measured about three inches in diameter. There was considerable rigidity and rebound tenderness over the mass and surrounding it, and a positive psoas sign was elicited. The temperature was 100.6°F., pulse 84, and respirations 24. A white blood count was done and a leucocytosis of 19,200 with 83 per cent polymorphonuclear cells, of which 7 per cent were staff forms, was found. The urine was entirely normal.

The history, physical signs, and laboratory data were considered typical of appendicular abscess and laparotomy was accordingly undertaken. The abdomen was opened using the Battle-Kammerer incision. The cecum and appendix were visualized and the appendix, though slightly congested and thickened, revealed no evidence of any suppurative process. The mass felt before operation was represented by an area of thickening in the posterior cecal wall. This posterolateral cecal wall was edematous and indurated over an area whose diameter was about 2½ inches. The surrounding parietal peritoneum was also markedly edematous. The cecum was bluntly separated posteriorly but no evidence of any pus could be found. The ileocecal region appeared grossly normal nor were there any enlarged glands. The exact nature of the mass in the posterior cecal wall was obscure, the differential diagnosis being between a malignancy and an inflammatory process in the cecal wall. It was decided to await developments and to base further therapy on these. The appendix was removed and the abdomen closed without drainage.

The pathological report of the appendix was as follows: Grossly, the appendix was deeply hyperemic. Microscopically, the outer surface of the appendix was occupied by inflamed

tissue, partly forming an abscess wall. The muscular coats and mucosa were entirely normal. Diagnosis: Periappendicitis. From this report, it was obvious that the appendix was secondarily involved.

Convalescence was relatively uneventful except for a low grade fever up to 102°F. which persisted for the first ten days. Two white blood counts done on the sixth and twelfth postoperative days showed a progressive drop to normal levels. The mass remained palpable and slightly tender throughout the patient's hospital stay but it diminished in size and became progressively less tender. Twenty days after admission, a colon *x*-ray was done and the following report was obtained: There are changes in the lower and posterior wall of the cecum which suggest carcinoma of the lower part of the cecum. There is marked dilatation of the terminal ileum and cecum. Another *x*-ray done three days later was reported as follows: Further examination shows changes in the cecum which suggest beginning new growth, nondestructive in character.

Despite the *x*-ray findings, the general improvement of the patient and the subsidence of the mass influenced us in thinking that the mass was inflammatory rather than neoplastic in nature. The patient was thus discharged on July 2nd, twenty-five days after admission and advised to return in one month.

On July 29th, the patient was examined in the out-patient department and the examiner's note read as follows: The abdomen is soft. The mass in the right lower quadrant is no longer palpable. The inflammatory nature of the mass seems to be substantiated. The patient complains of occasional abdominal cramps. General condition is markedly improved and the patient has gained ten pounds. A final *x*-ray done on September 9, 1932, gave the following results: The cecum appears to fill out normally. Marked ileocecal incompetency still present.

H. G. No. 106877. November 24, 1938. The patient was a thirty-eight year old white man admitted to the hospital complaining of abdominal pain of six days' duration. At the onset his abdominal pain was generalized but after twenty-four hours it shifted to the right lower quadrant. Nausea and vomiting were absent but anorexia and mild constipation were present. The temperature taken on several occasions ranged between 99 and 101°F. The only pertinent fact in the past history was a grippal infection about three weeks before the onset of his present illness.

The patient did not appear acutely ill. His temperature, pulse and respirations were normal and a white blood count revealed only a slight lymphocytosis with a total count of 5,600. On abdominal examination, there was a sharply localized area of tenderness over a narrow pencil-shaped mass in the right lower quadrant. This mass measured about 3½ inches in length and about ½ inch in width. In view of the paucity of findings, it was decided to observe the patient for further developments. On the second day after admission, the temperature rose to 100°F. and the mass became more tender. It was believed that we were dealing with an appendiceal abscess and the patient was therefore subjected to laparotomy.

The abdomen was explored through a Battle-Kammerer incision. On entering the peritoneal cavity, the omentum was found covering the cecum. When this was lifted, the cecum was seen to be reddened and edematous and there were numerous petechial hemorrhages over an area on the cecal wall, just lateral to the anterior tenia. This area measured about 1½ inches in length and ¾ inches in width. The appendix was visualized and though reddened, did not appear acutely inflamed. Palpation of the edematous area in the cecum, revealed the fact that the wall measured almost ½ inch in thickness and a vague central depression was palpable which, it was thought, might correspond to an ulcer. There were no enlarged glands in the ileocecal angle. A small portion of the indurated area in the cecal wall was excised for biopsy and the appendix was removed.

The postoperative course was uneventful, the wound healing by primary intention. The pathological report follows: Gross: Small, bloody strip of tissue, 0.9 cm. long, 0.2 cm. wide The center is occupied by a darker brownish round zone, 2 mm. in diameter. Slightly hyperemic appendix, 6.5 cm. long. Microscopic: Edematous, partly hemorrhagic inflamed connective tissue and fat tissue. Mononuclear elements prevail. The subserous layer of the appendix and adjacent portions of the outer muscle coat contain numbers of lymphocytes. In some blood vessels eosinophile leucocytes are numerous. Diagnosis: Inflamed tissue; periappendicitis.

Ten days following operation, an *x*-ray of the colon was taken and the following report was received: The colon is morphologically normal. The cecum is also morphologically normal but is characterized by marked increase in peristalsis. The presence of retroperistalsis suggests the possibility of a superficial ulcerative lesion, perhaps tuberculous in nature.

The patient was discharged on December 8th, fourteen days after admission, with no symptoms, but with the mass still palpable. He returned to the out-patient department on December 30th, still asymptomatic, but with the mass still palpable. On January 11, 1939, the patient was again seen in the out-patient department and at this time the mass could no longer be felt and the patient had gained five pounds in weight. An *x*-ray taken on January 17, 1939, showed only slight spasm in the cecocolic tract but no findings of any significance. On follow-up on July 12, 1939, the patient complained only of an occasional tight feeling in the abdomen. There was no tenderness and no masses could be felt.

REMARKS

Inflammatory disease of the appendix is the causative factor of most acute pains in the right lower quadrant of the abdomen. This fact has led many observers to deny the actual existence of the disease known as typhlitis (cecitis), a condition frequently diagnosed before acute appendicitis became known as a disease entity. As a matter of fact, Sprengel[37] in his book on "Appendicitis" states that if one excludes pelvic disease in the female, practically all cases of acute pain in the right lower quadrant are due to acute appendicitis. Cordes[8] in her article specifically contradicts this statement and points out that cases of typhlitis without any involvement of the appendix occur, both from her personal experience and from her survey of the literature. Our own cases and our study of the literature leads us to a similar conclusion.

The recognition of typhlitis or cecitis as a disease entity assumes importance in view of the delayed treatment of appendiceal abscess in the past few years. Lehman and Parker[38] in a recent article have described a delayed treatment of appendiceal abscess, and state that the majority of them disappear completely under such management. At elective operation some months later, they not infrequently find little or no abnormalities in the appendix. Ransom[39] also states that in some cases of appendiceal abscess, the mass may completely disappear and the appendix may be removed after some weeks or months as an elective operation. It is our opinion that some of these cases may never have been due to primary involvement of the appendix but represent instances of phlegmonous cecitis that have completely subsided. The two cases reported by us, if not subjected to laparotomy, would have been diagnosed as appendiceal abscess. The true nature of the disease was recognized only because they were operated at the time when the mass was present.

While casual inspection of our cases and those reported in the literature would lead to the belief that phlegmonous cecitis is an uncommon disease, we agree with Fenkner[18] that many of these are unrecognized because they are not subjected to laparotomy.

SUMMARY AND CONCLUSIONS

Phlegmonous cecitis is presented as a distinct disease entity.

The disease is uncommon but many cases are passed unrecognized.

Thirty-five cases have been collected from the literature to which we have added two of our own.

Differentiation between phlegmonous cecitis and appendiceal abscess can be made with certainty only at operation.

When the localized type of phlegmonous cecitis is found at operation, removal of the lesion is unjustifiable because spontaneous subsidence is the rule. In the diffuse phlegmon, the best results have followed ileocecal resection.

The mortality of phlegmonous cecitis in the thirty-seven cases was 8 per cent. The three deaths occurred in the diffuse type only.

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AN OPERATION FOR PILONIDAL SINUS

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A GREAT deal has been written within recent years on the subject of pilonidal sinus. According to information pilonidal sinuses today are causing more disability and hospitalization in Army Camp Hospitals than almost any other single condition. Multiplicity of methods indicates dissatisfaction with results. Some factors must explain the lack of uniform results obtained by the great variety of procedures which are being used.

The procedure which is here submitted has been used for the last fourteen or fifteen years, and while results have not always been perfect, they have been sufficiently good from the standpoint of primary healing to warrant consideration of this procedure.

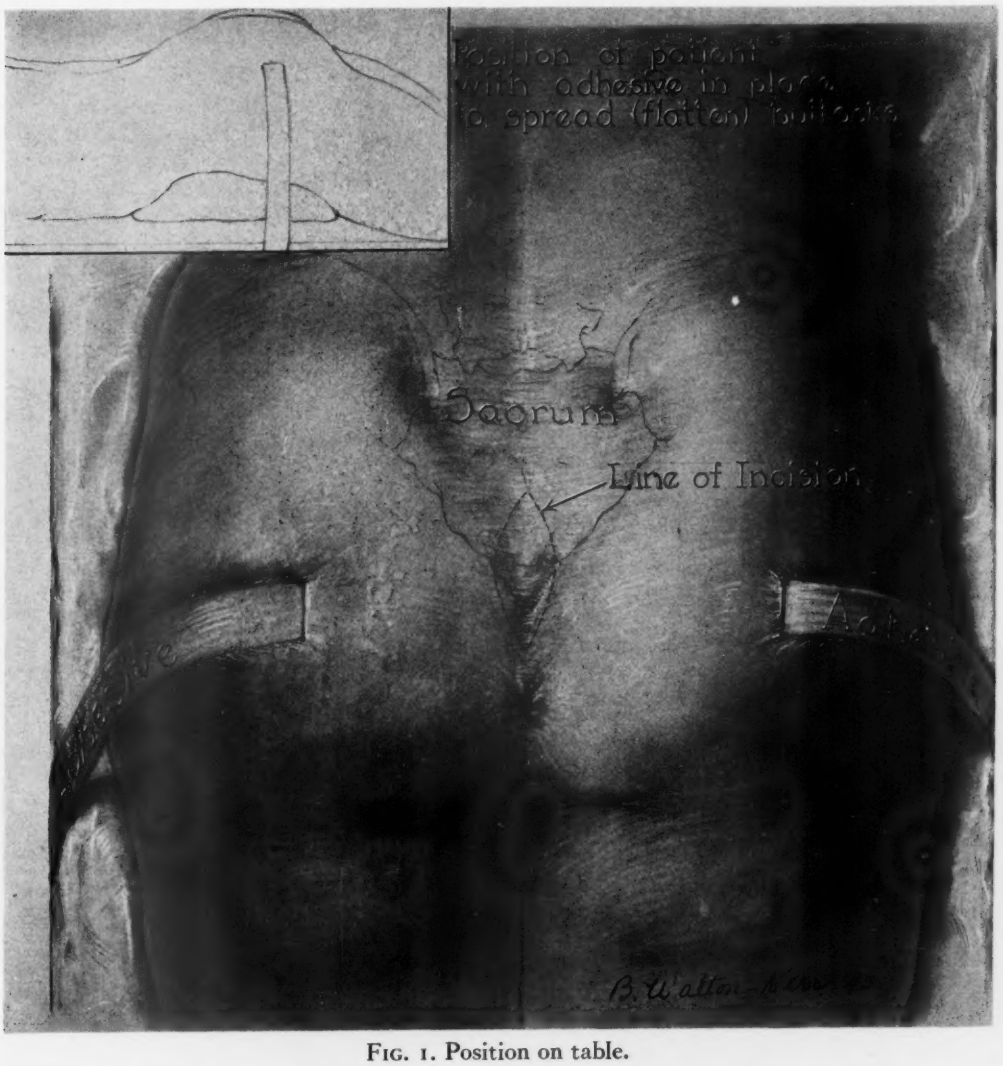

FIG. 1. Position on table.

There are certain fundamental principles underlying the management of pilonidal sinuses which all operations for their cure should observe: (1) The sinus or cyst must

be completely excised. (2) Hemostasis must be accurately obtained. (3) All dead space must be obliterated. (4) Primary closure is the method of choice. (5) In order to stimulate primary wound healing rest is essential. (6) There must be no tension on the suture line.

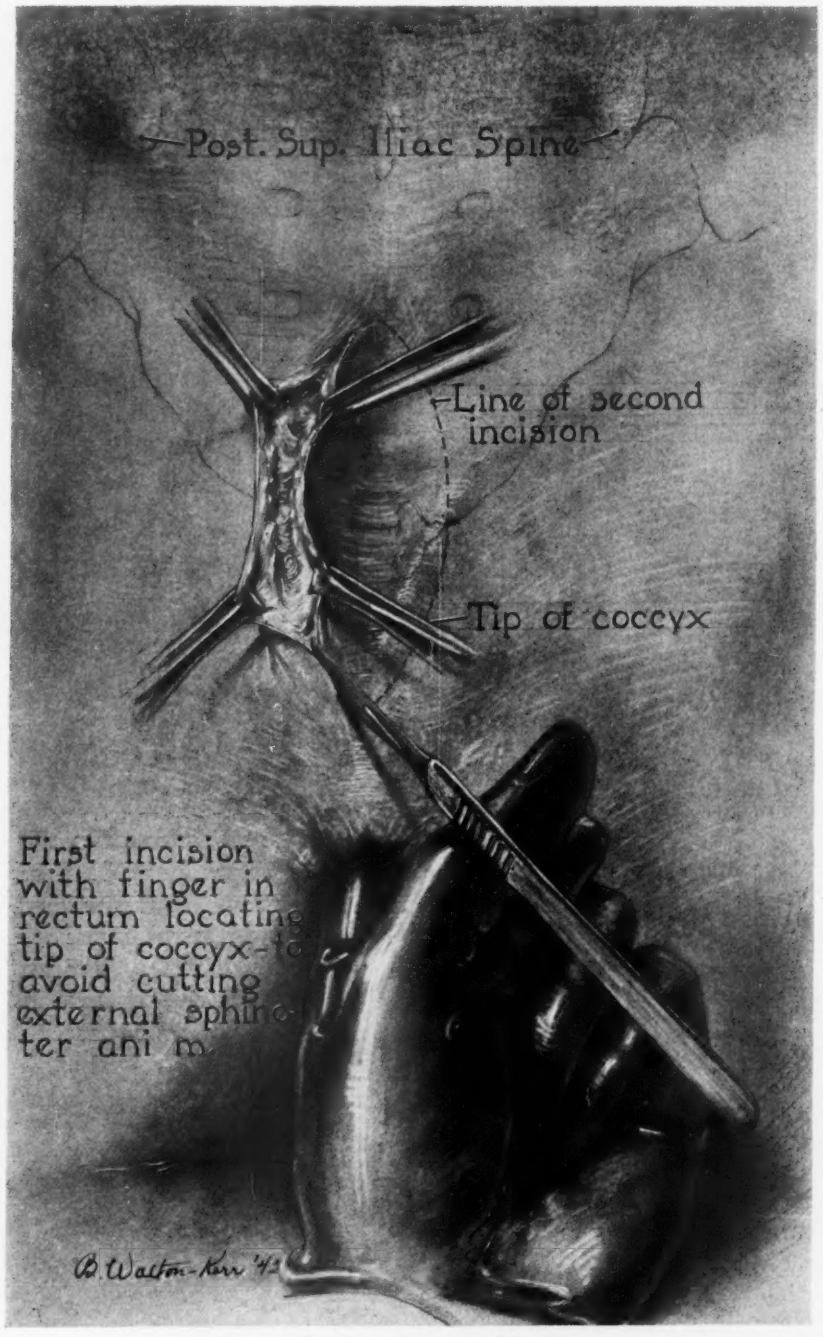
Post. Sup. Iliac Spine
Line of second incision
Tip of coccyx
First incision with finger in rectum locating tip of coccyx-to avoid cutting external sphincter ani m.

Fig. 2. Outline of proposed incision.

Etiology. Excellent studies have been made with reference to the origin of these sinuses and cysts. There is no unanimity of opinion as to the exact embryologic origin. There are two outstanding theories based upon careful studies: Harvey Stone[1] and S. L. Fox,[2] along with many others champion the theory that these sinuses represent an ectodermal invagination. Gage[3,4] in a splendid study reaffirmed the theory advanced by Tourneaux and Hermann in

1887: "True pilonidal sinus has its origin from maldevelopment of the caudal end of the medullary canal and that maldevelopment of the caudal ligament results in the postnatal sacral dimple or sinus."

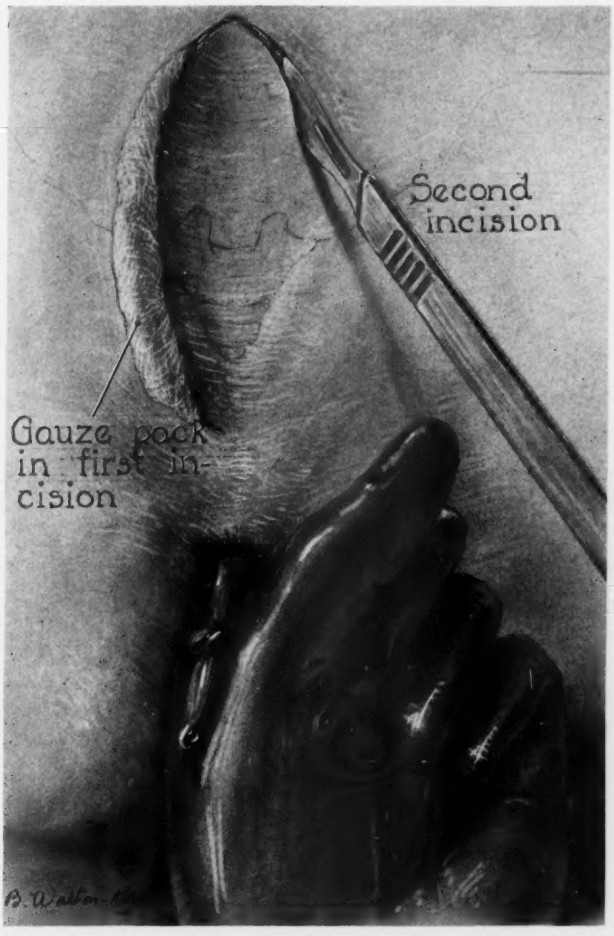

Fig. 3. Packing on one side while second part of incision is made.

The frequency of the existence of pilonidal sinuses and cysts is not definitely known. Prior to war mobilization I venture the opinion that physical examination of many patients did not include investigation of whether a pilonidal sinus existed or not. Many patients had their attention directed to this condition only when an acute infection required drainage. It is needless to say that infection of the sinus would not have developed if the patient had been adequately examined and operation advised.

The importance and the frequent incidence of pilonidal sinuses has been particularly emphasized recently because army regulations require that candidates have this congenital anomaly corrected before he can be accepted for military duty.

Personal observations and contact with members of the Medical Corps of the Army has encouraged the publication of the procedure detailed in this paper.

During 1942 and the early part of 1943 excellent articles have been published by Kooistra,[5] William F. MacFee,[6] J. E. Dunphy and D. D. Matson,[7] Woldenberg and Sharpe,[8] Milton Camp and Nicholas Polites.[9]

Recent communications on the subject of pilonidal cysts and sinuses have stressed the importance of complete excision, hemostasis, and obliteration of dead space.

Statistics with reference to the cure and healing time vary a great deal. One recent author reports 98 per cent cures and com-

plete wound healing in 21.5 days, another author reports 74 per cent cures and a period of twenty-six to twenty-eight days

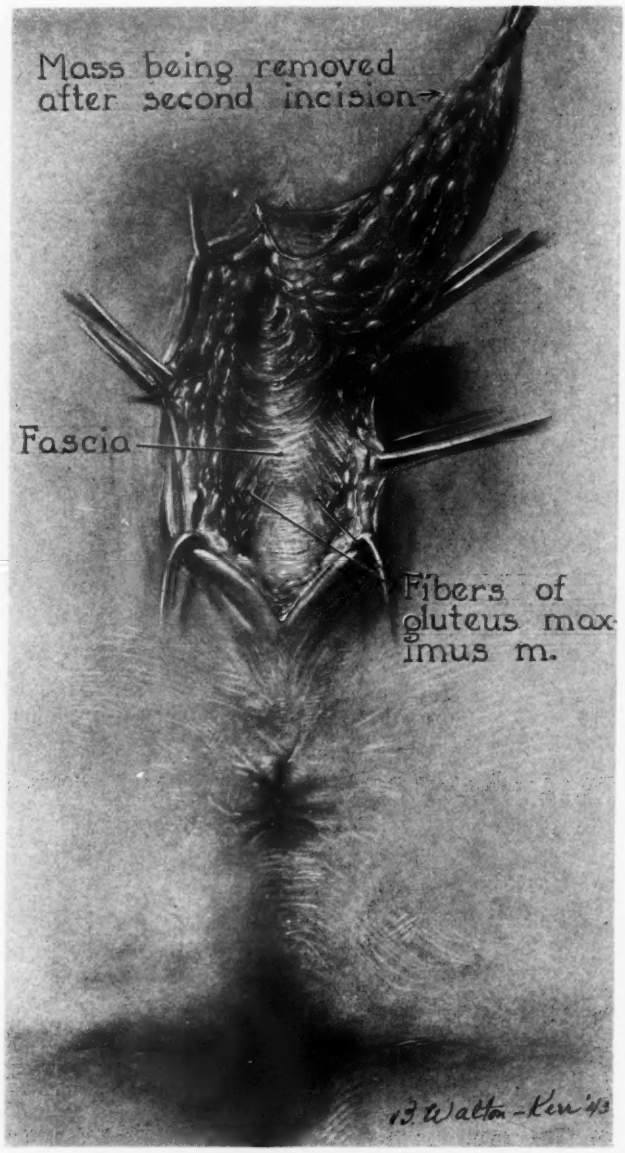

Fig. 4. Excision of all tissue down to the white fascia.

required for healing. MacFee reports the average healing time following suture of skin edges to coccygeal fascia in sixty-nine days. No statistics will be offered with reference to the procedure which is here submitted.

Since 1930, the following operation for pilonidal cysts and sinuses has been performed:

Position on Table. The patient is in the prone position with the buttocks elevated, either by means of pillows or an attachment to the table.

The buttocks are separated by making use of adhesive tape on either side and held to the side of the table. After proper preparation of a wide area, and after the operative field has been properly draped, the index finger is introduced into the rectum and pressed up against the coccyx. This enables the operator to know at all times the location of the attachments of the sphincter to the coccyx. This procedure helps to orient the operator and enables him to carry his incision immediately down

to the white fascia with greater mental comfort than if such a landmark is not used. This procedure may be objectionable to be ligated, probably the coccygeal branches of the sciatic artery. There are, of necessity, many small unnamed bleeding

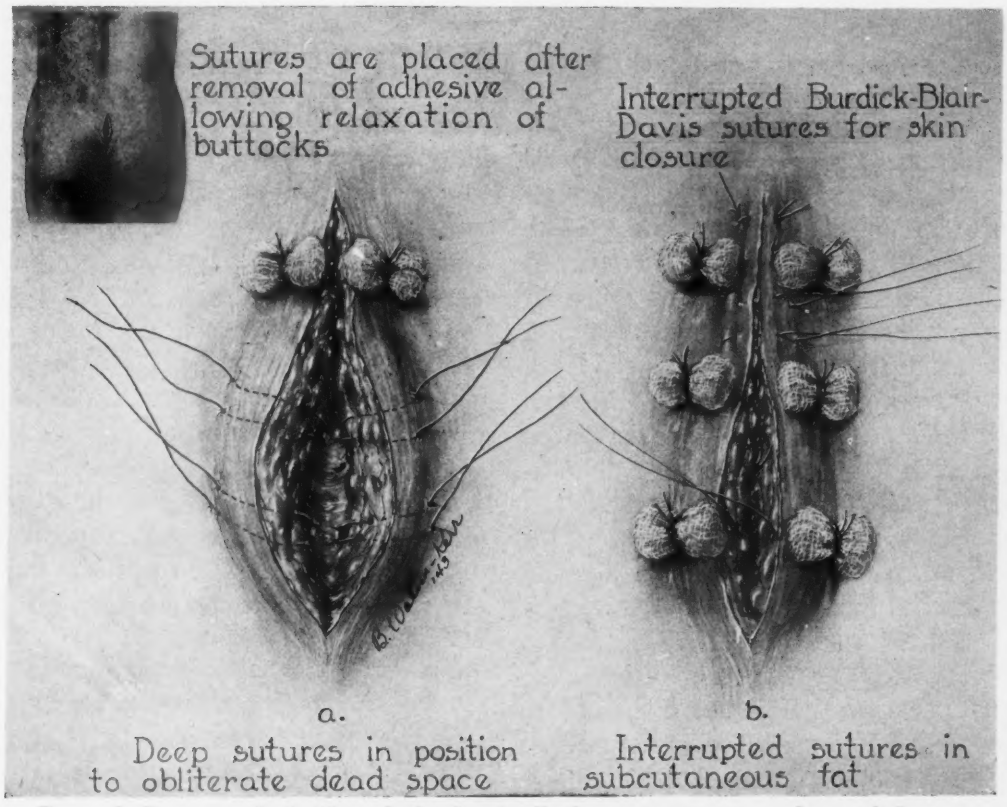
Sutures are placed after removal of adhesive allowing relaxation of buttocks
Interrupted Burdick-Blair-Davis sutures for skin closure
a.
Deep sutures in position to obliterate dead space
b.
Interrupted sutures in subcutaneous fat

Fig. 5. Indicates method of introducing longitudinal mattress sutures and wound closure.

to some on account of the possibility of contamination, but with adequate assistants the operator needs only his one hand, while his assistants maintain proper traction and retraction of the wound so that he can have adequate exposure. The primary incision extends through the fat well beyond the infiltrated area of the sinus or cyst, and in some instances the fascia covering the gluteal muscle is cut into. As soon as one-half of the ellipse is made, the wound is packed on that side and the ellipse is completed on the opposite side. In one mass the skin and sinus with fat down to the white fascia covering the sacrum and coccyx is removed. So far the steps are identical with every other procedure, the underlying principles of which are: adequate excision of all involved tissue, and complete hemostasis.

As a rule there are only two large vessels points. The use of a suction facilitates efforts to preserve a clean field.

The third step has to do with obliteration of dead space. A series of U sutures are introduced on either side about half an inch from the wound margin. These sutures are introduced first through the skin and are carried through the fat down to, and including the white fascia, a good bite of which is taken and then the needle is returned in the opposite direction back through the fat and out on the same side of the wound in which it was introduced. (Fig. 5A.) When these sutures have been introduced on either side of the wound, the subcutaneous fat is approximated with interrupted catgut sutures. The deep sutures are then tied over a small gauze roll. The skin edges are approximated with an everting type of suture, described by Burdick, Davis, and Blair independently.

No drainage is used in the majority of cases.

The wound is then dressed, care being taken that the adhesive dressing adequately brings the buttocks as closely as possible to one another, so that there will be no tension at any time on the wound margin. When the patient is returned to his bed, *he is kept in a prone position during the entire period of wound healing.* The common practice of allowing patients to assume the recumbent position, I believe to be one of the causes of some of the failures to obtain primary union. The recumbent position favors a separation of the buttocks and, therefore, an increase in tension on the wound; both conditions favor separation of wound edges.

Catgut has been the suture material used for all buried sutures and ligatures, and for the longitudinal mattress sutures dermal suture material has been used.

SUMMARY

1. An operation which has been in use for more than fourteen years by the author at the Touro Infirmary and Charity Hospital of New Orleans, is submitted for what it may be worth to others.

2. The fundamental principles are generally agreed upon: Complete excision, complete hemostasis, and obliteration of dead space without tension on wound edges.

3. The main point of variance with other procedures which have been submitted for this condition is the application of the mattress sutures at a distance from the wound edges, and not crossing in the midline, but coming out on the same side.

4. The after-care of the patient is particularly important. The main point which I believe should be stressed is the prone position. It is important that the patient not be allowed to be up and walking too soon. We generally preach rest and immobilization so that wounds will heal, and yet if the patient walks or sits down soon after an operation of this type, you cannot avoid increasing tension on the healing wound. I believe that this accounts for a good many delayed healing of these wounds which would otherwise unite by primary union.

The illustrations indicate the steps of the operation better than the word picture.

It is hoped that the procedure may be of service and be found worthy of use by others.

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TRAUMATIC RUPTURE OF THE SPLEEN*

EXPERIENCES WITH TEN CASES IN A GENERAL HOSPITAL

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RUPTURE of the spleen is said to be the most common of the serious subcutaneous abdominal injuries. Bronough (1935) reported that damage to the spleen occurs in 33.3 per cent of subcutaneous injuries involving abdominal viscera. Mazel (1932) reported a frequency of 30 per cent, while Wright and Prigot (1939) found the incidence to be 47.6 per cent, liver injury being next in frequency in the latter series with a 28.6 per cent incidence. These figures apply to peacetime, while in the present state of war, interest in traumatic injuries is increased with good reason.

Rupture of the spleen may be classified under the following six headings: Type 1. Spontaneous rupture of the normal spleen. Type 2. Spontaneous rupture of the diseased spleen. Type 3. Traumatic rupture of the normal spleen. Type 4. Delayed rupture of the normal spleen. Type 5. Delayed rupture of the diseased spleen. Type 6. Traumatic rupture of the diseased spleen. The first two of these types are not exactly apropos to the present discussion of traumatic rupture of the spleen, but for completeness will be included in the following discussion.

1. SPONTANEOUS RUPTURE OF THE NORMAL SPLEEN

This injury is exceedingly rare and, furthermore, many of the reported instances of its occurrence are open to the objection that an unrecognized previous abnormality of the organ may have existed. Susman (1927) suggested that the abnormality of the spleen may exist at one point only and that when the rupture occurs all evidence of pathologic change is destroyed. Grossman (1942) reported a case of spontaneous rupture of a normal spleen in an adult male. Even in this case there was evidence of a moderate degree of arteriosclerosis of the splenic arteries as well as suggestive evidence of a recent splenic infarction. Vanselow (1696) wrote a monograph in which he recognized the occurrence of spontaneous rupture of the normal spleen.

Zuckerman and Jacobi (1937) reviewed twenty-one cases of spontaneous rupture of the normal spleen, including one of their own. They ruled out trauma by lack of history and excluded previous abnormality of the organ by pathologic examination. Their own case had an abnormally mobile spleen and this may be a factor in some instances. The normal spleen is usually small and very well fixed in a protected position. Coleman (1939), like Grossman, found arteriosclerosis to be a factor in the causation of spontaneous splenic rupture in his single case. Ledderhose (1890), and Foucault (1925), and Smith (1934) all maintain that spontaneous rupture can occur only in a diseased spleen. For a review of this entire subject Susman's (1927), and Zuckerman and Jacobi's (1937) articles should be consulted. Up to 1937 they found twenty-one genuine cases and seven dubious ones in the literature. The condition was fairly evenly distributed throughout the various age periods and between the sexes. Pain in the left shoulder, although supposed to be a pathognomonic sign of splenic rupture, occurred only

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three times. This does not entirely agree with the relatively frequent occurrence of this sign (Kehr's) in delayed splenic rupture as reported by Zabinski and Harkins (at least 28 per cent of sixty-eight cases). Roettig, Nusbaum and Curtis (1943) found Kehr's sign of little practical value. In five of Zuckerman and Jacobi's cases, the onset of the attacks occurred shortly after eating or drinking. Watson and Ferdeber (1942) reported a case in which intimal thickening of the intrasplenic vessels was present. These authors emphasize Hamilton Bailey's aphorism that: "In atraumatic hemoperitoneum in the male examine first the spleen." Roettig, Nusbaum and Curtis (1943) state that a more critical review of the literature casts some doubt on the probability of the existence of this syndrome, which they believe can be accounted for in most cases by being instances of delayed rupture with the history of previous trauma being overlooked. These authors conclude: "We are hesitant to conclude that spontaneous rupture of a normal spleen can occur."

In conclusion, it may be stated that spontaneous rupture of the normal spleen is an exceedingly rare occurrence if it happens at all. We had no such cases in our series.

2. SPONTANEOUS RUPTURE OF THE DISEASED SPLEEN

This accident is especially common in India where malarial spleens reach huge proportions. Maes and Rives (1941) state that one-thirtieth of all deaths in the malaria-infested area about Calcutta are due to such an accident. The exact definition between "spontaneous" and "traumatic" rupture of these large spleens is often very arbitrary. This type of accident may be hard to distinguish, therefore, from Type 6 (traumatic rupture of the diseased spleen). Torres and Lacorte (1941) reported a case of fatal splenic rupture occurring in the second week of typhoid fever in a male, aged twenty-one. Acute perisplenitis, intracapsular hemorrhages, and distention of the capsule of a greatly enlarged spleen were present at necropsy. *Eberthella typhosa* were found in the blood and in pure cultures from the splenic tissue. The presence of two liters of blood in the abdomen accounted for the death of the patient.

In conclusion, it may be stated that in temperate climates where malaria is uncommon, this accident is very rare. We had no such cases in our series.

3. TRAUMATIC RUPTURE OF THE NORMAL SPLEEN

Acccording to Berger (1902), about 51 per cent of individuals who experience acute rupture of the spleen die of hemorrhage within an hour of the accident. While this estimate may be somewhat exaggerated, the *seriousness* of this condition is thus at once apparent. The *frequency* of the syndrome has been emphasized by Wright and Prigot (1939) (one out of every 666 accident cases of all kinds admitted to the Harlem Hospital) and by Roettig, Nusbaum and Curtis (1943) (one out of every 920 accident cases admitted to the Ohio State University Hospital).

In the present war, traumatic rupture occurs following the usual types of accidents (falls, motorcycle injuries, etc.), but more especially from two other causes. These are, first, being jostled against the side of a tank when travelling rapidly over a rough road, and second, as the result of blast injuries. This latter cause was discussed by Gordon-Taylor (1942) in his review of war injuries occurring in England and it is noteworthy that the spleen is the most frequently damaged abdominal organ following blast injuries.

Roettig, Nusbaum, and Curtis (1943) have divided the pathological lesions in traumatic rupture of the spleen into five groups: Group I. Complete fragmentation of the spleen into two or more parts or complete separation from the pedicle. Group II. Large tear near hilus. Group III. One large or multiple small tears of periphery of spleen. Group IV. Solitary small

tear of periphery. Group v. Subcapsular hematoma. All of the first four groups are subject to immediate collapse while the last two (IV and V) are particularly responsible for the development of delayed rupture (vide infra).

Traumatic rupture of the normal spleen is statistically the most important of the splenic injuries. Occasionally, it may represent an open damage (gunshot or stab wound) but most often the wound is closed. This very fact renders the diagnosis somewhat difficult. The most important factor in the latter is the awareness of the possibility of such a lesion. Local pain in the left upper quadrant associated with a history of trauma, signs of blood in the abdomen (pain, ileus, distention, rigidity), and evidence that the blood loss is progressive and large (shock, blood pressure fall, tachycardia, pallor, anemia, faintness, sweating, etc.) are the chief diagnostic signs. Abdominal paracentesis as advised by Wright and Prigot (1939) and opposed by Maes and Rives (1941), may be misleading. The senior author (H. N. H.) had one case* in which no blood was visible with the patient supine even after making a short exploratory incision. (The same occurred in Case IV listed below.) On enlarging the wound it was found that there was considerable fluid blood in the peritoneal cavity.

The question as to whether splenic lacerations can heal spontaneously and remain healed is an important one in deciding on operation in any case of possible splenic trauma. Webb (1940) believed that recovery without operation is rare, quoting Turnbull of London as stating that he has never seen a scar of injury to the spleen, and J. S. McCartney and E. S. Bell, who, in 25,000 necropsy records at the University of Minnesota saw no instances of healed splenic hematoma. On the other hand Gunther (1939), McIndoe (1932), Zschau (1939), Goinard, Viollet, and Marchione, and Hunter (1935) believed that splenic lacerations can heal spontaneously. This whole aspect of the subject is reviewed by Lommen (1942). Roettig, Nusbaum, and Curtis (1943) state concerning the healing of a splenic hematoma: "It is our conclusion that such a spontaneous cure rarely if ever occurs." Bailey (1927) evaded the issue nicely in this regard, stating: "The whole question of the natural repair of a splenic injury is an unimportant one. Nature fails so frequently that we must assume that surgical aid is always needed."

Untreated patients almost invariably die if the spleen is really ruptured. Berger reported 220 cases in which no operation was performed with a mortality of 92.3 per cent; Watkins, 100 per cent; Lewerenz, 85 per cent; and Connors, 100 per cent. Roettig, Nusbaum, and Curtis (1943) had seven untreated patients with six deaths (86 per cent mortality).

The possibility of splenic implants due to trauma which persist despite a splenectomy is to be borne in mind in the consideration of these cases. Hamrick and Bush (1942) found one such case in reviewing seventeen cases of traumatic rupture of the spleen seen at the Hillman Hospital, Birmingham, Alabama, during the six-year period 1933 to 1939. A boy, aged twelve, died following tetanus. Necropsy revealed several dozen microscopically identified spleens scattered throughout the abdomen measuring 0.5 to 1.0 cm. in diameter. Thirty-nine months previously (at the age of nine years) a splenectomy had been performed for a ruptured spleen six hours after a fall from a tree. These authors believed that the youth of the patient was an important factor in the survival of the splenic implants. This condition of splenosis is reviewed by Roettig, Nusbaum, and Curtis (1943) while Krueger and Mast (1942) have recently reported a case which, like that of Hamrick and Bush (vide supra), was also in a young (eleven year) boy.

Once the diagnosis is made, an immediate operation should be performed. In almost all cases, if the spleen is damaged, a

* Operation performed by the author in another hospital and hence not included in the present series.

splenectomy should be done. The first successful splenectomy for traumatic rupture was performed in 1892 (cited by Roettig, Nusbaum, and Curtis, 1943). These same authors concluded that: "The treatment of traumatic rupture of the spleen is always surgical and the operation of choice is splenectomy." The general trend toward an improvement in mortality can be gathered from Table 1, where it is seen that an operative mortality of better than 30 per cent can be reached. The data in this table include all types of cases and operations. In our own series, the mortality would be less (22 instead of 30 per cent) if the rupture of the diseased spleen were not included. The table does not, however, include open wounds of the spleen which have a much higher operative mortality (63.6 to 66.6 per cent, Rousselot and Illyne, 1941).

TABLE 1
RESULTS OF SURGERY IN SUBCUTANEOUS RUPTURE OF THE SPLEEN
(From Rousselot and Illyne, with additions)

Author	Year	No. of Cases	Mortality Per Cent
Bessel-Hagen	1900	37	46
Michelsson	1913	298	33
Buxton	1922	...	29
McIndoe	1932	37	27
Foster	1940	20	30
Rousselot and Illyne	1941	17	29
Harkins and Zabinski	1943	10	30
Roettig, Nusbaum, and Curtis	1943	15	7

CASE REPORTS

CASE 1. M. S., a female store clerk, married, aged twenty-eight years, fell down a flight of stairs on October 1, 1929, striking the left side of her chest. Immediately afterwards she had sudden severe pain in the left upper quadrant and fainted. She was seen at the hospital forty-five minutes later at which time she was in severe shock with a blood pressure of 80/60 and with extreme pallor of the lips and nails. There was marked tenderness in the abdomen, especially in the left upper quadrant. There was no shifting dulness in the flanks. After the administration of 200 cc. normal saline solution intravenously with 10 minims of adrenalin, the patient complained of a sharp pain in the left shoulder (Kehr's sign; possibly a renewal of the hemorrhage at this time caused a diaphragmatic irritation). The blood pressure was now 90/60, but soon sank to 62/48. A transfusion of 1,000 cc. citrated blood was then given with improvement in the general condition. A diagnosis of rupture of the spleen was made and four hours after the accident a splenectomy was performed through a left paramedian incision with a left transverse extension under ethylene and ether anesthesia. There was a large amount of fluid and clotted blood in the peritoneal cavity and a spleen weighing 220 Gm. with a horizontal tear almost completely across it was removed. After ligation of the pedicle, a large 4 inch gauze pack was inserted which was finally removed under ethylene anesthesia on the sixth postoperative day. A transfusion of 700 cc. of blood was given during the operation and another of 600 cc. afterward. Except for a slight bronchopneumonia of the left pulmonary base developing on the twelfth day the convalescence was uneventful and the patient recovered. There were no rib fractures. No red blood counts were done.

CASE 11. E. S., a white newsboy, aged thirteen years, was struck by a car while delivering papers at 3:15 A.M. on February 17, 1935. He did not regain consciousness until admission to the hospital at 6:00 A.M. At that time the skin was cold and clammy, the fingers and ears cyanotic, the pulse 116, respirations 34, and the blood pressure 74/38. The abdomen was rigid and markedly tender in the left upper quadrant. There was an associated fracture of the nose and of the left ninth and eleventh ribs. Despite the administration of 200 cc. of 10 per cent glucose intravenously, the child's condition became worse and he became paler. A diagnosis of probable ruptured spleen was made and at 1:05 P.M., nine and one-half hours after the accident, a splenectomy was performed under ethylene-ether anesthesia through a left rectus incision. A large amount of blood was found in the peritoneal cavity and preliminary examination of the spleen by palpation showed it to be of normal configuration with no lacerations. After exploration of other organs, the spleen was actually

visualized and it was seen that the vessels of the splenic pedicle entering the organ were torn. The patient received four blood transfusions totalling 1,600 cc. the day of operation, two before, one during, and one after operation. The abdomen was closed without drainage, and after splenectomy, recovery was uneventful. No red counts were taken before operation.

CASE III. N. M., a white male laborer, aged fifty-seven years, fell off a ladder from a height of seven feet one hour before admission on April 7, 1941, at 11:00 A.M. The patient landed face downward and some object struck him in the epigastrium. It is not known whether he was unconscious. When first seen, his blood pressure was 70/40, the white blood count 10,000; the red blood count 5,500,000; the abdomen slightly distended and tender in the left upper and right lower quadrants, and despite the high red count the patient appeared pale. He vomited and presented in addition a laceration of the lower lip. The patient was observed until 11:00 P.M., just twelve hours after the accident and eleven hours after admission. During this time his blood count showed the progressive changes shown in Table II. Roentgen examination revealed a large shadow of increased density in the left upper quadrant displacing the descending colon medially which is possibly a spleen. There were no fractured ribs. The blood pressure remained low although the patient improved somewhat temporarily, and was 84/62 at the start of the operation, despite the administration of 200 cc. of blood. Operation was performed at 11:00 P.M. under ethylene-ether anesthesia. The operative note gave the preoperative diagnosis as follows: "It was the writer's impression that a ruptured hollow viscus was present because acute symptoms had appeared rather early for ruptured spleen." (The writers of the present article believe that this reasoning is fallacious and exactly the opposite from the usual occurrence. In addition, an operation for rupture of the spleen twelve hours after the accident is "late" rather than "early.") The abdomen was opened through a horizontal incision just above the umbilicus. On seeing a large amount of blood in the peritoneal cavity, a vertical midline extension was added to the transverse incision making a T-shaped wound. A lacerated spleen in two pieces weighing 438 Gm. was removed. Microscopic examination revealed marked hemorrhage to account for the increased weight of the organ. The patient received 1,200 cc. of whole blood and 600 cc. of plasma during the operation and 500 cc. of whole blood after the operation. Except for a mild bronchopneumonia of both lungs, convalescence was uneventful and the patient recovered.

TABLE II
SERIAL BLOOD COUNTS IN CASE III

Date	Hour	Hemoglobin Gm	Red Count Millions	White Count	Polymorphonuclears Per Cent
4-27-41	11:00 A.M.	Time of accident			
4-27-41	12:00 M.	....	5.5	10,000	
4-27-41	3:00 P.M.	13.5	4.8	5,700	61
4-27-41	5:00 P.M.	13.4	4.8	22,000	
4-27-41	8:00 P.M.	....	...	32,000	92
4-27-41	11:00 P.M.	Time of operation			

CASE IV. C. J., a white male laborer, aged thirty years, fell fourteen feet into the hold of a ship on December 7, 1926, several hours before admission at 5:00 P.M. He struck himself in the left lumbar region and received fractures of the left seventh and eighth ribs. The patient was observed for a period of twenty and one-half hours in the hospital gradually becoming worse. His urine was bloody, the abdomen tender and distended. There was no shifting dulness. Operation was performed under ethylene-ether anesthesia through a left rectus incision with a "T" extension to the left. Considerable blood was encountered only after introducing the exploring hand. The spleen was found to be in two separate pieces which were removed, the pedicle ligated and the wound packed with gauze. The patient received one 500 cc. blood transfusion just after operation and another of similar size the next day. The removed spleen weighed 140 Gm. The patient died forty hours after operation. No red counts were done and no blood pressure readings are recorded. Necropsy showed a complete rupture of the left kidney with retroperitoneal hemorrhage, fracture of the seventh and eighth ribs, serosanguineous fluid (80 cc.) in left pleural cavity, and no intraperitoneal hemorrhage.

CASE V. E. G., a white male, aged eight years, fell four feet, landing on his abdomen, at 4:00 P.M. on April 2, 1931. The patient com-

plained of abdominal pain but had no nausea or vomiting or unconsciousness. On admission five hours after the accident, the temperature was 98.2°F., pulse 108, and respirations 24. The abdomen was diffusely tender and rigid. The white blood count was 25,000 with 95 per cent polymorphonuclear neutrophiles. The patient was treated for two days with a rising pulse rate and a temperature averaging 99° to 100°F. A chest roentgenogram was negative, however. The day after the accident the hemoglobin was 13.6 Gm. and the blood pressure 140/60. On April 4, 1931, at 11:30 A.M., i.e., forty-three and one-half hours after the accident, an exploratory operation was made with a preoperative diagnosis of intestinal obstruction, using ethylene-ether anesthesia and a right rectus incision. There was considerable blood in the peritoneal cavity associated with a tear across the middle of the spleen extending 2½ cm. into the substance. The upper end of the incision was extended to the left in an inverted "L," the spleen removed and the abdomen closed without drainage. The patient received 750 cc. of blood, 500 the day of operation and the rest the next day. Recovery was uneventful.

Comment. Few conclusions can be drawn from such a small series of cases, but several points may be emphasized which corroborate observations of other writers:

1. A rising or high white blood count may result from trauma or hemorrhage alone and is not necessarily a sign of infection. This point was reviewed by one of us (H. N. H., 1934) in other surgical conditions. Running a quarter of a mile may raise a normal person's white count to over 35,000 so it is not surprising if a splenic hemorrhage will do the same. Operation was delayed in Cases III and V, partly because of a high white count, for eleven and thirty-eight and one-half hours, respectively, after admission.

2. An increase in blood pressure, especially in young persons, may also be deceiving. One of us has observed that young persons with labile vasoconstrictive systems may overcompensate for hemorrhage in its early stages by an increase in arterial blood pressure. In fact, such a rise (occasionally to 180 or more mm. of mercury) in a young person should serve as a warning rather than offer assurance of safety.

3. The following interesting point is illustrated by Case II in which at first no splenic bleeding was found at laparotomy: Even though palpation reveals no laceration of the convexity of the organ, this does not rule out the presence of a serious tear of the pedicle and its vessels which can only be found by exposing the part to direct vision.

4. Large amounts of blood were required in these cases, 2,300, 1,600, 2,500, 1,000, and 750 cc., respectively. The last listed patient receiving only 750 cc. was only eight years of age, whereas the patient in Case IV receiving only 1,000 cc. was the only fatal case in this group. It is quite probable that if operation had been performed more promptly, less blood would have been necessary.

TABLE III
DELAY IN OPERATION IN FIVE CASES OF TRAUMATIC RUPTURE OF NORMAL SPLEEN

Case	Time from Accident to Admission—Hours	Delay from Admission to Operation—Hours
I	¾	3¼
II	2½	7
III	1	11
IV	1+	19½
V	5	38½
Average....	2	16

5. All types of incisions were employed because of the various preoperative diagnoses. In all of our cases ethylene-ether anesthesia was used.

6. Most important, the delay in operation, as shown in Table III, is outstanding. An average interval of only two hours existed from the time of the accident until the hospital admission, in itself testimony to the acuteness of the condition. Once in the hospital, however, an average additional delay of sixteen hours occurred. In Case II a delay of seven hours could be

attributed to no single specific factor, but in Case III, as already cited, an altogether erroneous idea of the course of a patient with a ruptured spleen existed in the mind of the attending surgeon resulting in a delay of eleven additional hours. In Case V, a mistaken diagnosis of pneumonia caused a thirty-eight and one-half hour delay. One of the purposes of writing the present paper is to bring about a better understanding of this urgent acute abdominal condition and to make such delays as those listed above less frequent.

4. DELAYED RUPTURE OF THE NORMAL SPLEEN

This syndrome has recently been extensively reviewed by the authors. This summary analyzed 177 cases collected from the literature including four of our own. The conclusions drawn from these cases and those reported in the literature are essentially as follows: "The total of 177 cases, while it represents over two and one-half times as many instances of this syndrome as have been reported in any previous summary, still does not represent the true frequency of this condition. Traumatic rupture of the normal spleen is the most common serious subcutaneous abdominal injury. Delayed splenic rupture (the *hemorrhagie en deux temps* of the French, or *zweizeitige Milzruptur* of the Germans) represents about 14 per cent (one in seven) (Table IV) of all splenic ruptures. This syndrome is especially insidious and treacherous due to the almost symptom-free latent period, but the delay offers an opportunity for diagnosis and treatment.

TABLE IV
RATIO OF DELAYED TO TOTAL SPLENIC RUPTURES IN REPORTED SERIES

Author	Year	Splenic Ruptures		Delayed Ruptures as Per Cent of Total Cases
		Delayed	Total	
Bailey (London Hospital)	1894–1926	6	32	19
Connors (Harlem Hospital)	1905–1927	3	32	9
Foster and Prey (Four Denver Hospitals)	1927–1938	1	20	5
Rousselot and Illyne (Presbyterian Hospital, N.Y.)	1941	1	17	6
Zabinski and Harkins (Henry Ford Hospital)	1926–1942	4	10	40
Roettig, Nusbaum, and Curtis (Ohio State University Hospital)	1943	2	8	25
Total		17	119	14

"Delayed splenic rupture is most common in males in the second decade of life. Falls and traffic accidents are the most common etiologic agents. About 50 per cent of the secondary ruptures occur after an interval of less than seven days while in an additional 25 per cent the latent period ends during the second week. Fractured ribs on the left side occur in about 10 per cent of the cases while Kehr's sign (pain in the left shoulder due to phrenic nerve irritation) is present in about 28 per cent or more of cases. Other diagnostic aids include those used in diagnosing any type of splenic rupture, such as sudden collapse or shock, rapid or increasing pulse rate, progressive anemia, white count from 12,000 to 20,000, absence of fever over 99°F., pain, tenderness, dulness and rigidity in the left upper quadrant, and in some instances signs of free fluid in the peritoneal cavity.

"Without operation, the mortality ranges from 77 to 100 per cent. At the time of McIndoe's review (1932) the operative mortality was 27 per cent. During the past decade it has been only 10 per cent. When splenic laceration is suspected, the patient should be kept in bed under close observation. In more definite cases, or at the first sign of secondary hemorrhage, splenectomy should be performed. Adequate treatment of shock with plasma or whole blood forms a necessary adjunct to the operative procedure."

In general, the pathologic lesion found at operation in these delayed cases conformed to those of Groups IV or V of Roettig, Nusbaum and Curtis. Referring to these authors' classification (vide supra) of the pathology of splenic rupture, if delayed rupture occurs in Group IV cases (solitary small tear of periphery), it usually is because of temporary clot or omental tamponade which finally breaks down. In Group V cases (subcapsular hematoma) the eventual rupture occurs either because the pressure behind becomes so great or because the dome of the hematoma breaks down and necroses.

5. DELAYED RUPTURE OF THE DISEASED SPLEEN

By the very laws of chance, this syndrome is extremely rare. Zschau (1939) reported a delayed rupture of a leukemic spleen. We had no such cases in our series.

6. TRAUMATIC RUPTURE OF THE DISEASED SPLEEN

As previously mentioned in the discussion of Type II ruptures (spontaneous rupture of the diseased spleen), the distinction between the spontaneous and traumatic cases is often arbitrary as in instances of large and friable, or merely friable spleens, a little trauma may cause rupture of a very big organ. In our series we had one such example with a fatal issue, a brief report being appended:

W. K., a male laborer, aged fifty-seven, was injured on August 31, 1937 at 4:00 P.M. and a splenectomy was performed the next day. The man was an old patient of the hospital for polycythemic vera. Thus, on August 27, 1931, when first seen, his hemoglobin was 132 per cent, and the red blood count 9,640,000. The spleen was palpable two to three finger breadths below the costal margin, there was 2+ albumin in the urine, and the blood pressure was 154/108. The patient was treated with phenylhydrazine for seven weeks, the final red cell count being 7,200,000, and was then lost track of until the day of the accident. He was injured at 4:00 P.M. on August 31, 1937. A laceration of the scalp was sutured and in the night he was brought to the hospital at 6:00 A.M., September 1, 1937. Further details of the injury are not available. On admission, fourteen hours after the accident, a roentgenogram of the chest demonstrated a fracture of the left eleventh rib in the posterior axillary line and consolidation of both lung bases. The patient was in profound shock (blood pressure 90/40). The pulse was 110, respirations 26, and temperature 102°F. The patient was pale, semicomatose, rousing at times and complaining of intense pain in the abdomen associated with marked tenderness but little rigidity. Splenectomy was performed at 1:00 P.M., seven hours after admission. Considerable blood was found in the peritoneal cavity and the spleen contained several deep lacerations. Two blood transfusions were given before operation, another of 750 cc. during and a fourth of 500 cc. after operation. Despite the blood, intravenous glucose, and oxygen therapy, the patient died at noon, September 2, twenty-three hours after operation and forty-five hours after the accident. Death was attributed to pulmonary edema and shock. No necropsy was obtained. The temperature two hours before death was 105°F., pulse 120, and respirations 30.

The removed spleen weighed 1,000 Gm. and measured 22 by 13 by 7 cm. The capsule was greatly thickened and along one edge there was a hyalinized plaque 12 by 3 by 0.3 cm. On the upper posterior surface there were two areas of superficial rupture measuring 5.5 by 1.0 cm. and 6.0 by 0.8 cm. There was interstitial hemorrhage and a subcapsular hematoma.

Comment. Earlier operation and recognition of the tendency of an enlarged spleen to rupture would have given this patient a better chance. A delay of fourteen hours occurred before admission to the hospital and another of seven hours in the hospital before operation was performed.

SUMMARY AND CONCLUSIONS

1. A classification of splenic rupture into six types is made.

2. From the practical standpoint, Types 3 and 4 are by all odds the most important. Of our ten cases, five are classified as Type 3, four as Type 4, and one as Type 6.

3. For traumatic rupture of the spleen, immediate splenectomy is the ideal mode of treatment.

4. For delayed traumatic rupture of the spleen, a similar therapy is essential, but almost as important is the realization that such a syndrome does occur. Traumatic rupture of the spleen of all types is the most frequent serious subcutaneous abdominal injury. At least one-seventh of all splenic ruptures are of the delayed type.

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DIAGNOSIS OF PERFORATED ULCER*

TWO USEFUL MANEUVERS BY MEANS OF WHICH PNEUMOPERITONEUM AND DIAPHRAGMATIC IRRITATION ARE DEMONSTRATED MORE CLEARLY

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PERFORATED peptic ulcer usually presents a classic abdominal picture. Severe abdominal pain, commonly in the epigastrium, early prostration, marked tenderness and board-like rigidity, low temperature, and slow pulse feature the event. Its differentiation from other abdominal catastrophes such as acute pancreatitis and mesenteric thrombosis is difficult at times.

Spontaneous pneumoperitoneum is pathognomonic. Weinberger[1] first noted radiologically "subphrenic pyopneumothorax" in 1908. Popper,[2] in 1911, observed air beneath the diaphragm and reported this in 1915. Wieland[3] also noted this in 1915. In 1925, Vaughan and Brams[4] demonstrated gas radiographically in the peritoneal cavity in thirteen (86.7 per cent) out of fifteen proved cases of peptic ulcer perforation. In 1929, Vaughan and Singer[5] reported positive evidence of pneumoperitoneum fluoroscopically in fifty-four (85.7 per cent) of sixty-three cases. In the series of Odom and Debakey[6] 106 (64.6 per cent) of 164 cases showed subphrenic air. Other investigators have found positive evidence roentgenologically in 67.7 per cent,[7] 70 per cent,[8] 83.3 per cent,[9] 98 per cent,[10] and 100 per cent[11] of cases. Debakey,[12] in a review of the literature, collected a series of 1,267 cases in which 879 (69.4 per cent) presented pneumoperitoneum by *x*-ray. It is our opinion that, on the average and in average hands, pneumoperitoneum is not observed radiologically, be it by film or fluoroscope, in more than 50 per cent of instances.

Cope[13] states that phrenic shoulder pain is present in more than 75 per cent of cases of perforated ulcer at some time in their clinical course. He notes that inquiry should be made concerning this pain since the abdominal pain usually overshadows that felt in the shoulder to such an extent that no spontaneous complaint may be made. According to Cope, the perforation of a duodenal or pyloric ulcer usually causes pain in the right supraspinous fossa or over the acromion process and less frequently over the deltoid and clavicular regions, anterior gastric perforations may produce referred pain in the left clavicular and acromial regions, and perforations near the cardia are apt to cause pain in both shoulders. In about one case in four, pain is felt in both shoulder regions. Oehlecker[14] specifically asked a group of patients about shoulder pain and found it present in 90 per cent of cases. His successors, Rodelius and Bruth, found it present in more than 80 per cent of their cases. Oehlecker reasoned that the falciform ligament directs the flow of fluid to either the right or left subphrenic spaces and that a large quantity would reach both sides. We have demonstrated this in the cadaver. The incidence of referred phrenic pain varies in different series from above to none in sixty-two cases.[15] In the low incidence groups, no notes as to specific interrogation are made.

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Of Debakey's[12] 1,657 collected cases, shoulder pain was found in 375 (22.6 per cent).

Clinically, obliterated hepatic dulness is a variable sign. Kellogg[16] states it is infrequent and was absent in 100 cases observed by him. Its incidence in the literature varies from this to 100 per cent as noted by Soupault[17] and Chabrut[18] (twenty-five cases). Field[19] noted changes in hepatic dulness which were more marked when the patient was allowed to lie on his left side. Bower[20] demonstrated the value of turning the patient from the prone to supine position to note this sign.

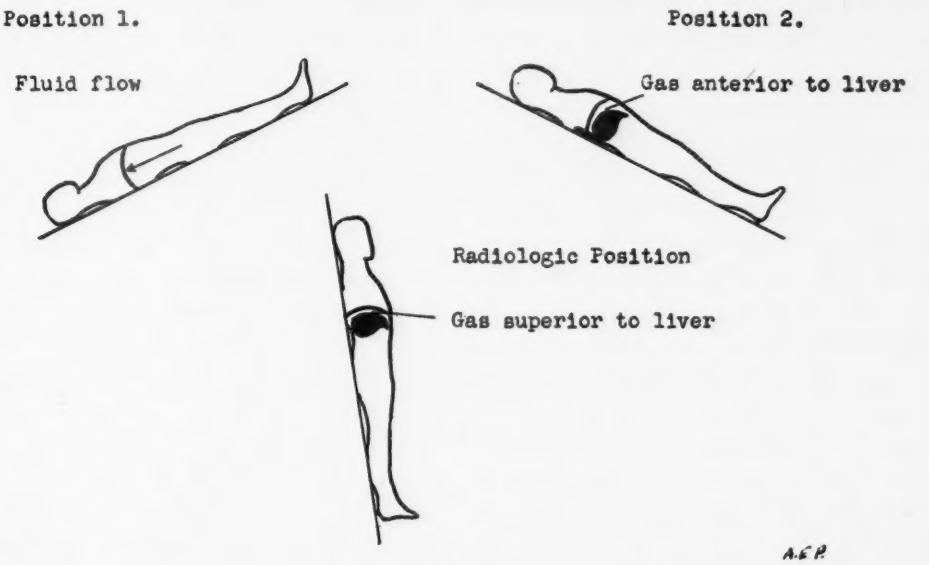

FIG. 1.

These maneuvers by means of which pneumoperitoneum and diaphragmatic irritation may be demonstrated more clearly, are best performed on the tilt radiographic table. The attending surgeon or resident should accompany the patient to the *x*-ray laboratory at the time when the scout film is taken. Positive findings, by this method, depend on the presence of either gas or fluid or both, whereas radiography is usually positive in the presence of gas only. The patient is placed supine on the table in the usual manner. First, Trendelenburg position of at least twenty-five degrees is instituted (position 1). When there is free fluid which flows toward the diaphragm, the patient may complain of referred phrenic nerve pain, spontaneously. Otherwise, specific interrogation should be made by the examiner. Cutaneous hypersensitivity in the shoulder regions should be noted.

Clinically, one may demonstrate, as Oehlecker[14] and Cope[13] have shown, "that irritation of the anterior portion of the diaphragm causes pain in the corresponding clavicular or supraclavicular regions; irritation of the posterior diaphragm causes pain in the supraspinous fossa of the same side; irritation of the top of the phrenic dome causes pain in the corresponding acromic-clavicular regions; and, finally, pain felt over both shoulders indicates a median diaphragmatic irritation."[13] At this time, hepatic dulness is also noted by percussion. After several minutes, the table's tilt is reversed and the head is elevated about twenty-five degrees (position 2). A small sandbag is placed beneath the right scapular angle. In this position, the gas lies anterior to the liver. One is able to note more easily obliteration of hepatic dulness because the space anterior to the right lobe of the liver presents the highest portion of the peritoneal cavity, and the gas collects there. For radiography, the head is elevated further so that the highest peritoneal pocket lies above the liver (radiologic position).

We have recently seen a case with abdominal pain of sudden onset, no rigid-

ity, and otherwise negative except for left supraspinous fossa pain. Laparotomy revealed a posterior gastric ulcer perforation. We have also been able to percuss obliterated hepatic dulness recently in six cases in which pneumoperitoneum was not detected by roentgenogram simply because the technician failed to have the patient sufficiently upright. It is, therefore, important to observe that in the clinical demonstration of pneumoperitoneum the elevation of the head should be twenty-five degrees whereas in its roentgenologic demonstration the elevation of the head should be as close to ninety degrees as possible.

It may be advantageous to operate with the patient in the head elevated position inasmuch as the perforation usually can be more easily approached. Further, concentration of suction in the pelvis permits a more complete removal of the free fluid which has gravitated there. A definite effort should be made to get as much of the gastrointestinal contents as possible out of the peritoneal cavity at the conclusion of the operation.

SUMMARY

The value of shoulder pain and its exact localization as well as the obliteration of hepatic dulness in the diagnosis of perforated peptic ulcer is discussed. The need for specific interrogation concerning the former is stressed. The use of Trendelenburg and reverse Trendelenburg positions in the demonstration of these two signs is presented.

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THEORY AND THERAPY OF SHOCK*

EXCESSIVE FLUID ADMINISTRATION

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EXPERIMENTS in the preceding paper showed that by refrigeration of the tissues from which shock originated, dogs gained a respite of time and strength to profit by administration of fluids in the stomach or under the skin. This carried an obvious suggestion to give the fluid intravenously, to equalize the absorption with nonrefrigerated dogs and also to increase the quantities. This was also logical because of the existing status of clinical treatment. Oxygen therapy has failed to overcome the anoxia. Changes of bodily position are worthless in shocked animals; and while there may be some benefit for cardiac or vasomotor collapse in patients, authorities have pointed out that the traditional head-down position is irrational for the capillary stasis of shock and probably lacks even emergency value. Adrenal extract is either discredited or at least not demonstrated to the satisfaction of many competent judges. The one universally accepted effective treatment of shock is the intravenous injection of fluids, especially blood plasma or its substitutes. Nobody claims that the severest shock is curable by any method. Also, severity is not governed merely by the original cause, but excessively long continuance of shock creates the most dangerous state. The irreversibility of very advanced shock is undisputed. Any therapeutic advance requires an attack on this problem of irreversibility. The existing information on it must, therefore, be examined. The survey can be brief and general, because of the detailed references supplied in the excellent reviews of Blalock and especially Harkins and Moon.

In beginning, the remarks concerning anesthesia in the preceding paper need to be amplified. The sensitization to histamine produced by anesthetics has been noted by the Mylon-Winternitz group and earlier writers. The barbiturates in particular can cause low blood pressure, anoxia, reduced volume flow and increased concentration of the blood. These effects deceptively imitate and may to some extent be identical with shock, but there is also a fatal action of entirely different character. Moon has emphasized this complication and has used it to attack a considerable part of Blalock's experiments. He also quotes Mann and others to the effect that many investigators have been studying deep narcosis instead of shock. Recently Muirhead, Ashworth and Hill have correctly described the effect of nembutal, which may be responsible for apparent failures of plasma treatment in shock.

Anybody can easily confirm this result as follows: The proper intraperitoneal dose of nembutal in shock is about one-third to one-eighth of the normal average, depending upon the degree of shock. This fractional dose produces in the shocked animal the same degree of unconsciousness which is produced by a full dose in a normal animal, namely surgical anesthesia with retention of the conjunctival reflex. These minimal doses suffice for all needs and are permissible because they do not spoil any experiments; in particular, dogs receiving any effective treatment for the shock wake up quickly. A full normal dose in the shocked animal is fatal, as can be proved by tests in prolonged shock, and by the failure of every kind of treatment to save

* From the Department of Physiology and Biochemistry, New York Medical College, New York City. Aided by a grant from the Committee on Scientific Research of the American Medical Association.

life. Remarks of authors such as Mahoney, that "the pulse, blood pressure and respirations remained well within normal limits when no shocking procedure was carried out," are meaningless. The essential fact is that when shock is induced rapidly, so that it reaches a severe stage during the maximum effectiveness of the anesthetic, the narcosis deepens as the shock deepens and the combination is hopeless.

The reason for insistence on this small technical point is that it means nothing less than the discarding of a large part of the literature of shock. For example, Wiggers stresses the irreversibility of shock, and also properly insists on technical precision and the training of his students in anesthesia. But this is the very point in which his large data collide with a small fact. The customary method was described by Wiggers and Werle: "As in previous experiments, dogs under morphine sodium barbital anesthesia were bled until a period of marked hypotension was maintained for 30 minutes to 2 hours. At the end of such a period, the withdrawn blood was reinfused and the course of dynamic events followed for 4 to 5 hours, unless death occurred earlier." This appears to be a formula for narcotic poisoning. Unless the small fatal error of anesthesia can be disproved, the entire work of Wiggers on shock must be rejected. Shock is according to generally accepted definition a capillary process, and Wiggers' introduction of a primary cardiac or possibly vasomotor factor in the fatal outcome is not admissible unless it is demonstrated in pure shock. The point of main interest in the present connection is that Wiggers has no evidence of the irreversibility of shock.

Simple saline solutions were the first to be used with therapeutic effect, beginning with the famous O'Shaughnessy-Latta cholera treatment in 1831. Pilcher and Sollman, in 1914, showed that after prolonged hypotension from hemorrhage, the blood pressure of dogs could not be restored or their lives saved by restoration of the blood volume with salt solution or the original blood. Smith and Mendel, in 1920, proved that saline injected in rabbits in amounts equal to the calculated blood volume mostly passed out of the circulation during the injection or within five minutes afterward. Lumière, in 1924, recommended large saline infusions for anaphylactic shock, but preferred an addition of 3 per cent gum arabic. Underhill gained credit for his introduction in 1927 of large volumes of salt solution in the treatment of burns. MacFee and Baldridge, in 1934, emphasized the dehydration factor in shock and the value of large saline infusions, their extreme example being a patient who received 4,000 cc. in two hours. Recently, however, Rhoads et al. reported a case of burn in which 5,000 cc. of saline was given in nine hours and the hematocrit reading nevertheless rose to 77 per cent. Also in 1934 Atchley and Loeb, after a historical review of the O'Shaughnessy cholera treatment and the obstruction of progress by the medical centers of that time, listed various states of dehydration and shock treated with saline infusions, the highest dosage being 7,200 cc. in a case of rattlesnake bite, and concluded that the ideal treatment of shock is by transfusion; "when salt solution has failed, transfusion may turn the tide." The preferred position given to saline solution by Hoitink was due only to primitive transfusion methods and the disadvantages of gum arabic. The experiments of Hepler and Simonds accorded with present-day views by showing that saline infusions equal to the calculated blood volume kept the blood pressure of (etherized) shocked dogs elevated for only one to three minutes after the stopping of the injections, and that harm was done by increasing tissue edema and loss of protein from the blood. Most recently, Abbott and Mellors have emphasized the impoverishment of plasma proteins in dehydrated malnourished patients, rendering them susceptible to edema with the consequence that infusions of 2,500 to 7,000 of physiological saline create danger of pulmonary edema, atelectasis and bronchopneumonia.

The saline injections in the literature of shock have usually ranged from small amounts up to the estimated blood volume as a maximum. Davis's experiments were exceptional, in that he studied the metabolism after shock was produced by hemorrhage, limb trauma, portal vein ligation or histamine injections in dogs of 10 to 20 kg. weight, which then received 0.9 per cent sodium chloride solution into the femoral vein at the rate of 16 cc. per minute until 3,000 cc. had been given. This admirably comprehensive plan showed an abnormal metabolic response to fluid in shock. In normal dogs, a maximum increase of metabolic rate by 25 to 50 per cent was reached after injections of 1,400 to 2,400 cc. and then remained at a plateau. Fluid to the extent of 25 per cent of the body weight could be injected without deleterious result. In traumatic shock, the maximum metabolic increase was reached after infusion of 700 to 1,200 cc., and there was a progressive decline with further injection. The tolerance for fluids was diminished; the anoxemia of shock was intensified, through impairment of both transportation and utilization of oxygen, with quantities of fluid which would not affect a normal animal. The result of the experiments in general was that the saline infusions caused increased leakage of plasma proteins and hastened death. The dogs were under sodium barbital anesthesia, and the description of anoxemia, urinary suppression and early death corresponds to my own experience with narcotic poisoning in shock.

The failure or harm of saline and the superiority of plasma, serum or substitutes for maintaining blood volume and composition are affirmed without exception by investigators of all possible states of hemorrhage and shock, experimentally and clinically. Besides the older citations given by the reviewers, a partial list of the recent supporters of this view comprises the J. G. Allen-Dragstedt group, Buttle et al., Dunphy and Gibson, Freeman, Gutman et al., Harkins and McClure, Helfrich et al., Konrich, Mahoney et al., Muirhead et al., Weil and Meakins, and White et al. The general tendency is to emphasize the large quantities of fluid and plasm protein lost in shock, and to report better results with larger and larger infusions of plain, diluted or concentrated plasma or serum or substitutes. Nobody denies that a certain degree or stage of shock is irreversible and irremediable by any of these measures. Blalock took pains to prove that blood transfusions fail to save unanesthetized dogs in the late stage of hemorrhagic shock, and the experimental and clinical observations with plasma lead to the same conclusion for advanced shock of every origin.

My experiments published in 1939 agreed with Blalock and others in showing that blood transfusions in severely shocked rats resulted in overstuffing the blood vessels with blood of progressively increasing corpuscle content, and that life was prolonged but not saved. In other experiments, successive injections of plasma were given in such a manner that the corpuscle counts were kept approximately normal or actually reduced from beginning to end. Hemoconcentration in the ordinary sense was thus prevented, and the blood volume was evidently not diminished because in the later stages the vessels were visibly distended and plethoric. Life was preserved longer than with whole blood, but was not saved. These experiments still appear to be the most decisive on record with regard to the limitations of plasma treatment. They might be interpreted in favor of the toxic theory of shock. On the other hand, the fact that blood or plasma from rats dead in shock was practically as beneficial as normal blood or plasma for the temporary revival of shocked rats showed at least that no high concentration of toxin could be circulating. Saline infusions succeeded in severe shock where the plasma failed. But (owing perhaps to deficient constitutional strength of rats or to the unavoidable anesthesia) the severest degrees of shock proved fatal in spite of any treatment.

Although Moon furnished the best phrasing of the idea that "the wheal is shock in miniature," he did not draw the therapeutic inference which seemed to me logical. Is it rational to try to prevent formation of the wheal? Since shock is by definition a fluid shift, and the injured tissues evidently somehow need fluid to form the "wheal," why not help them to form it by supplying a fluid that will pass readily through the capillary walls? As mentioned in the preceding paper, the conceptions of physicochemical equilibrium, capillary permeability and tissue need or avidity are doubtless more or less synonymous, and abnormal permeability can presumably be compensated by a change in fluid composition. But the different phrases create different superficial impressions, since we can expect a tissue need for fluid to become satisfied after sufficient fluid is provided, but the believers in abnormal permeability have inferred that the capillaries would continue to pour out water, salts and protein until the organism was drowned. Accordingly, ever since the first introduction of the colloid concept and gum arabic, physicians and experimenters have unanimously concentrated on treating the blood instead of the patient. The real task is to cure shock which cannot be cured by blood or plasma. If this can be accomplished, the correction of any deficiency of the blood in cells or protein is a secondary problem. According to this concept, when a therapist makes the stereotyped complaint. "I have given large saline infusions and they do not prevent hemoconcentration and only carry protein with them out of the vessels," the proper answer is, "Excellent. Now continue to give more saline until the tissue demands are satisfied so that fluid remains in the vessels and hemoconcentration is abolished." The precise question to be answered experimentally therefore is: Can salt solution establish a lasting equilibrium between the intravascular fluid and the extravascular fluid of the "wheal," or will plasma depletion and edema formation continue to an unlimited and fatal degree? The main point in my rat experiments was that within wide degrees of shock the former result is attainable.

EXPERIMENTS WITH EXCESSIVE FLUIDS

In the first type of experiments to be illustrated, dogs in the extreme stages of fatal shock produced by leg ligation were given either continuous physiological saline infusions by cannula or else repeated large injections (with a 50 or 100 cc. Luer syringe and an 18 gauge needle), the latter being usually preferred. One jugular vein had previously been exposed under the light anesthesia previously described, and by the time the injections were begun the weakness and apathy had reached a point which precluded any struggle. In this first type, the total volume of injections was intentionally excessive, to ascertain the disposal of the fluid and its effects.

Dog 267 (Table 1) was shocked by six and one-half-hour ligation of both hind legs, and three and three-quarter hours later was near death, with reduced rectal temperature and high red cell count. The blood was extremely dark, as seen in the poorly filled jugular vein and the scanty sample obtained from the ear. The dog might have died within a few minutes and certainly could not have lived an hour. A quick emergency injection of 200 cc. saline was considered necessary, and was followed with a slower continuous drip. Weakness, or pulmonary rattles heard with or without a stethoscope, were a signal for slower infusion. Within twelve hours the dog thus received saline intravenously to the extent of about two-thirds of his body weight, and the net result of injection, water drinking and profuse diuresis was a gain of about one-third of the original body weight. There was a general swelling of the body, such as Cutting and associates have described, trivial amounts of fluid in the serous cavities, and perceptible edema of the face and eyes, but the principal feature was the tremendous edema in the hind legs and spreading from them up to the thorax. Therapeutically, the dog which was near death from shock was enabled to live twenty-one and one-half hours.

Dog 360 (Summary of record). This was a female pup not quite grown. It weighed 8 kg.

Nembutal (180 mg.) was given at the beginning and no further anesthetic administered. Tourniquets were placed on both hind legs at 1:15 A.M. and removed at 10:15 A.M. (nine hours). The animal was conscious and apparently comfortable. By noon the red cell count had risen from the original 5.3 to 8.3 millions. The dog was conscious, not dying, but limp and inert in any position and entirely heedless during exposure of the right jugular vein. Between 12:05 and 12:20 P.M., 1,200 cc. saline were injected in vein. At the end of the injection the dog sat up and behaved almost normally, but at 12:35 P.M. it lay flat again. The animal drank 300 cc. of water. 1:35–1:55 P.M., injected 1200 cc. saline. Urine: 350 cc. at 1:20 P.M., 450 cc. at 2 P.M., and 210 cc. at 3 P.M., with the usual 1012 specific gravity. Red cells (millions): 3.8 at 1 P.M., 4.2 at 2:45 P.M. Rectal temperature 97°F.; there were coarse rales in the chest. Increasing weakness and convulsive twitching took place and death occurred at 3:30 P.M. Immediate autopsy showed the stomach to be very full of water,

TABLE I

DOG 267

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	7:45 A.M.	.....	...	5.7	Nembutal 180 mg. Weight 15 lb. (6.8 kg.).
	8:15 A.M.	.....	...	...	Hind legs ligated.
	11:30 A.M.	.....	...	...	Nembutal 60 mg.
	2:45 P.M.	.....	...	...	Tourniquets removed (6½ hr.).
	3 P.M.	.....	...	8.0	
	6:30 P.M.	.....	...	9.4	Nearly dying. Blood dark. Temp. 94°F.
	6:35 P.M.	200	...	...	Rapid injection, followed by slower continuous drip.
	6:45 P.M.	.....	...	...	Awake, crying. Blood pressure unobtainable. Nembutal 60 mg.
	8 P.M.	.....	...	8.5	Ear blood still dark, scanty.
	9:30 P.M.	.....	340	...	Slight diarrhea.
	10:15 P.M.	.....	300	6.9	Lightly asleep, strong.
	11:30 P.M.	.....	500	5.7	Moderate diarrhea. Temp. 96°F.
2	12:30 A.M.	.....	270	...	Weaker. Slight rattle in breathing. Infusion made slower.
	1:30 P.M.	.....	120	5.5	Awake. Sits up. Drinks 200 cc. water, later 220 cc. more.
	3 P.M.	.....	430	3.5	Stronger. Good respiration, 24 per min. Temp. 99°F. Blood brighter and more abundant.
	4:30	.....	320	...	Stronger, requires tying. Drank 200 cc. water. Brachial pressure 136/74 (auscultation).
	5:30 P.M.	.....	...	4.2	
	6:30 P.M.	4500 cc. total	300	...	Finished injection. Weight 20½ lb. (9.3 kg.). Able to walk.
	11 P.M.	.....	...	3.4	Alert but weaker. Ear blood red, profuse.
	4 P.M.	.....	...	2.1	Edema of face and body. Too weak to stand. Temp. 87°F.

Totals up to 6:30 A.M., 4500 cc. saline injected, 620 cc. water drunk, 2580 cc. urine. Lacrimation; bulging eyeballs.

In extreme weakness at 4 P.M., given transfusion of 200 cc. normal blood without anticoagulant, without benefit. Death. Immediate autopsy.

Congestion and edema of lungs. Usual gross findings with edema. Spleen normal size but very dark. Microscopic: "Lungs, frank consolidation by a fibrinopurulent exudate within bronchi and alveoli; there are a few isolated areas of hemorrhage. Spleen, extremely engorged pulp, normal follicles. Liver, kidney, adrenal normal."*

Oxalated samples were taken from blood of distended heart and from copious edema fluid of hind legs. Total protein 3.6 per cent in blood and 1.4 per cent in edema.

* All microscopic reports on tissues were by Dr. James R. Lisa, as mentioned later.

the usual general wetness, congestion and edema of lungs and huge thigh edema. Examined microscopically, the adrenals and the grossly edematous pancreas were normal.

Here the circulation was overloaded with two sudden injections, each considerably larger dose of nembutal. With the onset of shock after removal of the tourniquets, all the nembutal seemed to have a cumulative effect, resulting in dangerous unconsciousness with absent conjunctival reflex and very low temperature. There were no observations on blood pressure,

TABLE II

DOG 361. WEIGHT 5.5 KG.

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	9 A.M.	....	...	...	Nembutal 150 mg.
	9:15 A.M.	....	...	5.3	Both hind legs ligated. Water 100 cc. by stomach tube.
	9:30 A.M.	....	...	...	Nembutal 60 mg.
	2 P.M.	....	...	5.4	Nembutal 60 mg.
	2:15 P.M.	....	...	...	Tourniquets removed (5 hr.). Unconscious.
	2:20 to 2:35 P.M.	1000			
	2:50 P.M.	....	...	...	Deeply unconscious.* No conjunctival reflex. Slight diarrhea; very few cc. urine. Stomach tube yields 200 cc. clear fluid, neutral, NaCl = 0.676%.
	3:15 P.M.	....	100	4.1	Ear blood bright red, profuse. Conjunctival reflex returning. Stomach empty.
	6 P.M.	....	125	7.0	Still unconscious; good eye reflex. Temp. 93°F. in very warm room.
	6:30 to 6:40 P.M.	500	...	...	Wakes briefly. Temp. 94°F. Stomach empty.
	7:30 P.M.	....	250	4.2	Thirsty; not yet able to drink.
	8:30 P.M.	....	200	...	Water 100 cc. by stomach tube.
	9 to 9:15 P.M.	500			
	9:30 P.M.	....	...	...	Drinks 100 cc. water. Curls up in normal position to sleep.
	10:30 P.M.	....	Lost	4.8	Temp. 96°F. Responds to petting. Drinks 100 cc. water.
2	1:30 A.M.	500	Lost	5.1	Responsive. Drinks 100 cc. water.
	5 A.M.	....	Lost	4.2	Ear blood copious, thin, bright.
	8 A.M.	....	Lost	4.4	Stronger. Temp. 98°F.
	11 A.M.	....	Lost	4.7	Weakening. Apathetic.
	2 P.M.	....	...	...	Found dead.

Autopsy. Heart nearly empty. Lungs normal. 50 cc. clear fluid in peritoneum, none in thorax. Spleen normal size but very dark mottled. Usual general wetness. Huge edema of hind legs. Microscopic. Lung, pancreas, liver normal. "Spleen: the pulp is deeply engorged but no other changes are evident. Kidney: most of the tubules contain an amorphous granular detritus. Adrenal: the cytoplasm of the reticular cells is foamy and pigment appears very scanty. The glomerular and fascicular zones appear normal. The medulla is normal."

than the estimated blood volume. The effect was necessarily injurious, but instead of a quick fatality the dog lived twenty-nine hours, i.e., several times as long as it could have lived untreated with the severe shock of a nine-hour ligation.

Dog 361 (Table II) first illustrates the danger from even a slight narcotic poisoning. Shortly before removal of the tourniquets the dog was crying, and was put to sleep with a fractional but the oliguria may have been connected with hypotension. Diuresis increased as the narcosis passed off.

The fluid intake of 2,500 cc. saline and 500 cc. water amounted to more than one-half of the body weight. This treatment was started early, so that all important hemoconcentration was prevented and the blood was almost continuously dilute, as indicated by the slightly subnormal red cell counts. The survival for nearly

twenty-four hours after removal of the tourniquets is a multiple of what is possible after a five-hour ligation without treatment. The absence of pulmonary edema is noteworthy.

Dog 353 (Table III). As compared with dog 361 (Table II) this was a smaller saline injection in a larger dog with more severe shock. The shock from a nine-hour ligation is rapidly fatal, but treatment was begun early before the condition was critical. The saline seemed mostly to be bound by the tissues, for free diuresis did not begin except with the drinking of 950 cc. of water. After the first saline injection, hemoconcentration was effectually prevented. As in the other experiments, here also the fluid did not continue to pour out of the vessels. The dog lived over fifty hours after removal of the tourniquet. The notable features are the extremely long survival with this very severe form of shock, and the dilution of the blood as indicated by subnormal red cell counts to the end.

Dog 354 (Table IV), in the act of dying from shock, was restored by the saline infusion. Life was prolonged to the fifth day, and the vessels were filled with an apparently increased volume of dilute blood throughout this time. It was rather surprising that on the third day, with marked hydremia present, the strength was distinctly improved by another infusion of 1,000 cc.

Distemper was prevalent in the laboratory. In the terminal stage the dog exhibited fever, pus in eyes and nose, diarrhea and typical rash on abdomen and groins. The pneumonia found at autopsy was of a degree which often causes death in normal dogs. This dog survived the ordinary period of shock, and apparently might have recovered completely except for distemper. Obviously the shock and the infusion may have increased susceptibility to the infection.

In order to learn what part of the results were due to shock, it was evidently desirable to

TABLE III

DOG 253. WEIGHT 7 KG.

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	10 P.M.	...	...	5.7	Morphine 15 mg. subcut. Nembutal 180 mg. intraper.
	10:15 P.M.	...	...	...	Both hind legs ligated.
2	1:00 A.M.	...	...	...	Nembutal 60 mg.
	7:15 A.M.	...	...	6.4	Tourniquets removed (9 hr.). Awake, comfortable.
	8:30 A.M.	...	...	8.1	Lethargic; heedless of dissection of jugular. Blood dark. No immediate danger.
	8:35 to 8:50 P.M.	900	...	...	Sits up nearly normally.
	9:30 P.M.	...	...	5.5	Slight diarrhea. Ear blood profuse, bright red.
	10:30 P.M.	...	...	4.6	Stronger, more active. Heart 250. Drinks 150 cc. water; vomits.
	11:30 to 11:40 P.M.	600	170	4.9	Stronger. Heart 190. Drinks 500 cc. water; vomits.
	1:30 P.M.	...	...	4.7	Stronger. Heart 156. Drinks 550 cc. water in installments; retains it.
	4:00 P.M.	...	360	4.3	Drinks 400 cc. water.
	6:00 P.M.	...	280	3.9	Walks well except for paralysis and huge edema of hind legs.
	9:00 P.M.	...	310	4.1	Caged for night, in apparently good condition.
3	8:00 P.M.	...	Lost	4.2	Weak, but alert and responsive. Slight diarrhea.
	4:00 P.M.	...	Lost	4.4	Same. Ear blood less bright and copious.
4	10:00 A.M.	...	Lost	4.1	Extreme collapse. Died under observation.

Autopsy. Heart contracted and nearly empty. Dark blood clots quickly and firmly. Dark red engorgement and large edema of hind legs; blood-tinged edema over abdomen. Kidneys wet; other organs normal; no edema of lungs or pancreas; no fluid in peritoneum. No microscopic examination.

TABLE IV

DOG 354. WEIGHT 8 KG.

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	8:30 A.M.	....	.....	4.6	Morphine 15 mg. subcut. Nembutal 180 mg. intraper.
	8:50 A.M.	....	.....	...	Both hind legs ligated. Water 200 cc. by stomach tube.
	11 A.M.	....	.....	...	Nembutal 60 mg.
	11:30 A.M.	....	.....	...	Nembutal 60 mg.
	2:50 P.M.	....	.....	4.7	Tourniquets removed (6 hr.).
	5:20 P.M.	....	.....	9.0	Extremely dark scanty blood.
	5:50 P.M.	....	.....	9.6	Complete apnea. Heart nearly failed.
	5:50 to 6:05 P.M.	1000	.....	...	Heart and respiration restored. Unconscious; good conjunctival reflex.
	6:30 P.M.	....	140	4.7	Slight diarrhea. Ear blood bright red, profuse.
	7:15 P.M.	....	130	8.3	Jugular again poorly filled.
	7:20 to 7:35 P.M.	1000	.....	...	Stronger. Slight diarrhea.
	8 P.M.	....	.....	6.5	Notices surroundings.
	9 P.M.	....	600	5.8	Conscious, but too weak to move.
	9:30 to 9:45 P.M.	1000	.....	...	Begins to move. No rales in chest.
	10:30	....	620	3.5	Stronger. Slight diarrhea.
2	2 A.M.	....	Abundant lost	4.6	Profuse bright thin ear blood. In cage.
	4:30 P.M.	....	Lost	5.1	Stronger. Drinks 300 cc. water.
	8:30 P.M.	....	Lost	5.7	Drinks 240 cc. water. Behaves normally except for swollen paralyzed legs.
	5 P.M.	....	Lost	4.9	Weaker. Drinks unmeasured water.
3	11 A.M.	....	Lost	3.6	Very weak. Barely sits up. Temp. 103°F. Labored respiration.
	12 to 12:15 P.M.	1000	250	...	Slightly stronger after infusion.
	1:30 P.M.	....	Lost	3.5	Stronger. Retains 200 cc. milk by stomach tube.
	5 P.M.	....	Lost	3.5	Ear blood profuse, thin, bright red. Edema from huge thighs over entire flanks and abdomen.
4	9 A.M.	....	Lost	3.3	Depressed and weak. Edema diminishing. Ear blood still profuse bright red. Milk 200 cc. by tube.
	8 P.M.	....	None	3.2	Milk 100 cc. by tube. Vomited. Temp. 103.6°F.
5	8 A.M.	....	120	...	Spec. grav. of urine 1020. Milk 200 cc. by tube. Weak. Temp. 99°F.
	6 P.M.	....	.....	3.0	Has had small convulsive movements. When lifted, went into convulsion and died.

Autopsy. Heart and great vessels full of thin-appearing blood. Lungs slightly congested; left lower lobe intensely hepatized. Abdominal organs neg. Bone marrow pale. Edema of hind quarters much diminished but still large. Thigh muscles very dark, apparently from old blood pigment.

Microscopic: Lung (right); several foci in which alveoli are small and filled with edema fluid and a few red corpuscles. Most of the bronchi contain fresh hemorrhage and a small amount of edema fluid. Kidney; amorphous material in lumen of convoluted tubules; otherwise normal. Spleen; architecture preserved; prominent feature is lack of blood and moderately dilated capillary sinuses. Liver normal. Adrenal; medulla normal. Fascicular zone comprises most of cortex. Glomerular zone narrow, cells clear. Reticular cells, foamy, have little or no pigment. Thigh muscle; acute degeneration in fibers; marked edema in interstitial tissue; endothelial proliferation with a few monocytes and lymphocytes. An occasional artery has a hyalin thrombus.

carry out a similar procedure on normal dogs. This plan differs from all previous undertakings by Cutting and others, in that it seeks to avoid overwhelming the animals by a rapid overdose, and tries to allow maximum time for adjustment by slow or spaced injections over several hours.

Dog 373 (Table v) was a normal male which received approximately 900 cc. of 0.85 per cent sodium chloride solution per kg. during eight and one-half hours, and died two and one-half hours afterward. The longer time interval, therefore, did not give a very great advantage to this dog as compared with the cats of Cutting and associates, which were killed acutely by about 700 cc. of 1 per cent sodium chloride solution per kg., infused at the rate of 5 cc. per kg. per minute, with a retention of 550 cc. per kg. The figures for the dog do not represent a minimum lethal dose, because it seemed evident that if the infusion had been stopped earlier, death would still have occurred after a longer time.

Some dilution of the blood occurred at first, as anticipated. The rising corpuscle counts toward the close are not understood. It may be argued that the large saline infusion caused shock by washing protein out of the circulation,

TABLE V

DOG 373

Day of Experiment	Hour	Saline Cc.	Urine Cc.	Red Cells, Millions	Incidental Notes
1	3:00 P.M.	....	....	5.6	Weight 11½ lb. (5.2 kg.). Morphine 20 mg. subcut. Nembutal 90 mg. intraper.
	4:00 P.M.	....	....	...	Saline infusion begun through cannula in right jugular.
	5:00 P.M.	500*			
	5:30 P.M.	....	460	...	Nembutal 60 mg. Awake, strong. Heart 90, resp. 20, temp. 97°F.
	6:30 P.M.	500			
	7:30 P.M.	500	620	4.4	
	8:30 P.M.	500	....	...	Restless. Morphine 8 mg. subcut.
	9:15 P.M.	500	....	...	Mucous rales. Infusion slowed temporarily.
	10:15 P.M.	500	1040	5.9	
	11:00 P.M.	500	....	...	Rales and dyspnea increased. Heart weaker.
	11:45 P.M.	500			
2	12:15 A.M.	....	510	...	Temp. 96°F. Resp. 20, puffing. Heart 140, too weak to count except by auscultation. No rales. Extreme weakness. Dribbling urine. Gray liquid diarrhea. Conjunctival reflex present; anal sphincter relaxed. Watery fluid drips from nose, but stomach tube yields only 25 cc. thick mucus.
	12:30 A.M.	500	30	...	Nearly dying. General swelling of body. Abdomen distended and tender. Infusion ended. Body weight 15¼ lb. (6.9 kg.).
	1:15 A.M.	....	....	6.8	Edema of eyelids.
	2:10 A.M.	....	140	...	Heart and respiration feeble.
	3:00 A.M.	....	....	...	Death after gradual choking.
		Saline total 4500	Urine total 2860 cc. with 90 cc. watery feces.		

Autopsy. Heart distended. Lungs edematous. Peritoneum distended with large ascites. Liver dark, not specially large, congested or wet. Spleen dark, not enlarged. Kidneys congested and wet. Adrenals normal. Pancreas not markedly edematous. Microscopic: Kidney normal. Liver; entire capillary bed is extremely engorged. Adrenal; medulla normal. Cortical zone narrow, no definite pathology.

* The infusion was continuous. Each figure for saline is the quantity given in the period ending at that hour.

but the seemingly increased blood volume which distended the heart at autopsy is hard to reconcile with the corpuscle counts. Repetition would be necessary to exclude accidental local changes in the ear blood with the failing general circulation in this one animal.

Dog 408, female, not quite grown, weighing 12 pounds (5.45 kg.), was kept quiet but conscious with very small sedative doses of nembutal and morphine, and received 0.85 per cent sodium chloride solution intravenously as follows: 10 A.M., 400 cc.; 11 A.M., 400 cc.; 12:15 P.M., 400 cc.; 4:45 P.M., 500 cc.; 6 P.M., 500 cc. The urine totalled 870 cc. The body weight was increased to 14¼ pounds (6.48 kg.). The body looked swollen, and the dog was groaning and dyspneic because of a large tense ascites. Next day the dog acted well, the ascites was gone and the weight was 11 pounds (510 kg.). Red cell counts, in millions, were: before the experiment 4.9; 10:55 A.M., 4.6; 12:10 P.M., 5.4; 4:15 P.M., 4.8; 8:30 P.M., 3.6; next day, 5.1.

Here the injection of 400 cc. saline per kg. during eight hours produced signs indicating a near approach to the limit of safety, which together with a very marked blood dilution lasted more than two and one-half hours after the final injection. Three differences from shocked animals were noticed, namely, the earlier and more marked ascites, the more rapid restoration of a normal blood count, and the refusal to drink water at any stage.

REMARKS

In the absence of organic disease, the tolerance limit for physiological saline solution is evidently high. Cutting and associates pointed out that a tolerated dosage of 500 cc. per kg. in cats would correspond to 35 liters for a 70-kg. man, infused as rapidly as 350 cc. per minute. The tolerance for hypertonic salt solution or for glucose solution is lower. Cutter recommended an actual infusion rate of 20 to 40 cc. per minute for patients in shock. Conservatism in clinical trials is suggested by the fact that human beings are more subject to edema than cats or dogs.

To assess the influence of shock, a comparison may be made between the shocked dog 267 (Table 1) and the normal dog 373 (Table v), which received the identical dose of 4,500 cc. of saline. The former dog being slightly larger, this infusion equalled about two-thirds of the body weight, while in the normal dog it was nearer to five-sixths of the body weight. But the drinking of 620 cc. of water by the shocked dog raised the total intake to about three-fourths of the body weight. The net result was that the fluid retention was not far from one-third of the body weight in each animal. The infusion occupied twelve hours in the shocked dog and only eight and one-half hours in the normal dog, but as the shocked one was near death when the infusion started, the result is highly creditable to both its diuretic function and circulatory adaptation.

The immediate therapeutic effects of large saline infusions in shock are spectacular. Inasmuch as circumstances did not permit of setting up apparatus for the elaborate records which critics might demand, the plan was adopted of letting at least one animal in each class of experiments reach the point of death. Death in shock always occurs by apnea, while the heart beats strongly and then fades out. This fact seems to fit poorly with Wiggers' suggestion of a primary cardiac factor in the fatality, especially when allowance must be made for some impairment of heart function by anoxia. The evidence of the degree of shock in these experiments is furnished by the corpuscle counts, and by waiting until the breathing has stopped and sometimes until the heart action has almost ceased (Dog 354, Table iv). This test in any form of true shock (not acute hemorrhage) is believed to be not only decisive proof of the final stage but also a more extreme standard than any other investigator has ventured to set up for any form of therapy. The uniform result is that the saline infusion restores life. As long as any effective flicker of heart action remains, the salt solution together with artificial respiration and some massage of the thorax is successful, without a failure or exception.

As the infusion continues or the large injections are repeated, the shrunken blood

vessels become filled or distended to such a point that a nick in an ear vein may start a veritable hemorrhage. The correction of anoxemia can be affirmed positively even without oxygen analyses, because the dark purplish blood not only regains normal color but also goes on to a point at which the venous blood is almost as bright tinted as ordinary arterial blood. Hemoconcentration is replaced by a dilution of the blood, in the sense of subnormal corpuscle content and also the reduction of plasma protein to be described later.

Mention may be made here of a few incidental observations. One atypical dog gave a series of red cell counts only between 6 and 7 millions when the clinical signs indicated a nearly terminal state, and then the injection of 250 cc. of saline suddenly raised the count to around 9 million, the evident interpretation being the opening of dammed-up capillaries to release packed corpuscles. In contrast to the reports of delayed clotting in shock, cursory examinations of blood from ear veins and autopsies of injected animals indicate an approximately normal clotting time, though the coagulum in the dilute blood is scanty and pale. Consciousness returns more or less rapidly, as shown in the various protocols. Cutting and associates reported absence of any marked elevation of blood pressure in normal animals, and workers with smaller injections have obtained only slight or transitory elevations in shock. In severe shock no sounds are audible with the auscultatory method, but scattered observations show that the large infusions produce well sustained elevations to normal levels or above, and the sounds are clear and sharp. Sufficient evidence on this point seems to be furnished by the abundant diuresis which is the rule after the tissue needs are satisfied, if narcotic poisoning is absent. Isosthenuria is practically invariable during the injections, the specific gravity being monotonously fixed at 1012–1014, though the retention of kidney function is indicated by lower figures sometimes with copious water drinking or higher figures near the beginning or after the end of the injections.

As there are not the albumin, casts or renal disorders of nephritis or nephrosis, the condition is chiefly comparable with the hydremia and edema of avitaminosis and malnutrition. Somehow a new equilibrium becomes established lasting at least for a term of days. Blood volumes are among the many obvious and necessary studies which could not be made, but supervolemia is plainly suggested by the copious thin bleedings from the ear veins. Anemia is a probable concomitant because of the blood loss with some (and possibly to some degree with all) of the shock methods in this investigation. The regeneration of plasma proteins being reported as retarded in shock (Ebert et al.), the question is open how this process and also corpuscle formation behave under the infusion treatment. The apparently rapid recovery of the blood under the most successful treatment encourages the hope that neither the leg ligations nor the infusions have much anemic effect. This question might be studied further with shock produced by injection of a colloid such as dextrin which presumably does not destroy erythrocytes.

Large scale injections of any markedly hypertonic salt solution are obviously a therapeutic impossibility, unless very copious drinking is feasible. The surprising amount of water drinking shown in the tables might create the suspicion that all the saline injections were hypertonic, but the following incidental comparisons were made. The shocked animals were thirsty when injected with 0.9 per cent sodium chloride, 0.85 per cent sodium chloride, Ringer solution, or (to less degree) plasma. Normal dogs receiving similar saline injections refused water. One possible explanation is that traumatic exudation creates thirst, like a hemorrhage; the untreated animal is too apathetic and too limited in absorptive power to drink much, but after treatment the needed water can be taken. Beyond this, however, is the apparent fact that thirst is greatest with

the largest saline injections. Therefore, the solution being isotonic but not isoionic with the body fluids, shocked dogs seem to differ from normal dogs in having some unexplained need for water to adjust their ionic equilibrium. Hypotonic injections were not tried. Frequently, however, solutions were made up crudely with one flat teaspoon of table salt to a pint of tap water, and notwithstanding the huge volumes the results were indistinguishable from those with a precisely weighed amount of pure salt in distilled water. It may be of practical importance to understand that in emergencies a hasty makeshift preparation of salt solution is (except for possible pyrogens) permissible and harmless in shock treatment.

The opposite process of eliminating fluid through the stomach is one of the dangers of the largest injections, as the Cutting group mentioned. Up to a very high limit of infusion the stomach remains empty except for a mere trifle of mucus. But if the overloading of the circulation becomes too extreme, there seems to be a rather sudden flooding of the stomach with watery liquid, suggesting reverse peristalsis from the intestine. An animal may save itself if able to vomit, but the accident mostly occurs in those which are too weak or unconscious, especially with excessive narcosis. Regurgitation and fatal aspiration into the lungs are then not noticed until too late, and a number of experiments were thus spoiled until the lesson of making watchful use of the stomach tube was learned.

The ability of animals at the point of death to withstand the circulatory overload with actual benefit for such long periods seems to furnish positive proof of either normal function or quick recuperation of the heart, vessels and vasomotor system. But in spite of the dramatic initial improvement, none of these overflooded animals finally recovered. The cats studied by the Cutting group showed no such prolonged edema, hydremia or fatal course. If the saline infusion was stopped just short of a certain sharp endpoint, within twenty-four hours all of the salt and 80 per cent of the water had been eliminated by the kidneys. This might imply a critical disturbance created by the shock, but the Cutting infusions were finished within two hours, and my fatal experiment with a normal dog indicated that when the fluid overload is continued for over eight hours, the animal may die even more quickly than the shocked animals. The facts of present importance seem to be, (1) that the animal in advanced shock retains a tolerance for salt solution fully equal to that of a normal animal; (2) that the fatal process after excessive saline is opposite to shock in such cardinal features as hemoconcentration (replaced by dilution), oligemia (volume becoming supernormal), and anoxemia and anoxia (the venous blood showing bright red superoxygenation, and the clinical improvement showing utilization of the oxygen).

It has been possible to save space by abbreviating the gross autopsy reports, because all details were precisely as described by the Cutting group. The general evidences of excess fluid are broadly similar in the shocked and the normal animals, and the extreme edema of the pancreas is frequent in both series. Cutting and associates found an invariable absence of brain edema, and examination of the central nervous organs was omitted in my animals notwithstanding the occasional twitchings or slight convulsions. This central nervous immunity may be lacking in man because of the greater tendency to edema.

The lungs are the weakest point in the circulation and the most acute deaths are from pulmonary edema. The lung engorgement and edema, described by Moon and authors whom he cites, raise a particularly interesting question. Since the animal dying from shock has lungs already in this condition, what will be the effect of a saline infusion large enough to endanger the lungs of a normal animal? In addition to the great and obvious improvement in

respiration, the autopsies corroborate the statement of Davis that the tendency to lung edema is reduced in traumatic shock. The shocked animal likewise has comparatively little effusion in the peritoneum or other serous cavities. The normal animal must dispose of fluid in some such desperate manner, but in shock the traumatized area constitutes a point of least resistance or a dumping place for fluid, which acts as a safety valve for the circulation. Hence the traumatized limbs acquire a prodigious edema, beyond comparison with anything ever seen without infusions, and this fluid migrates for long distances under the skin of neighboring parts. Because of the inflammation and capillary injury the swelling in the traumatized parts naturally requires several days to clear up by absorption.

These facts have also a theoretical significance. Supporters of the purely physical theory may argue: The symptoms of extreme shock are relieved by a mere fluid supply, therefore, there is no toxin. More especially, abnormal capillary permeability can be demonstrated by easier and more copious outpouring of fluid. This increase of permeability is strikingly demonstrated in the traumatized parts, but in the rest of the body there is no increase as compared with normal animals. The upholders of the chemical or toxic theory may still maintain that local metabolites cause or contribute to the capillary phenomena in the damaged parts, and that these substances become distributed through the body and set up similar but slighter capillary changes. Whatever the cause of the shock state, it is either cured or compensated by a sufficient supply of salt solution. The remedy evidently takes the form of a new fluid equilibrium between blood and tissues. This equilibrium is reached not only throughout the general circulation but also in the traumatized parts where the capillary damage is extreme and undeniable. It is demonstrably false that the damaged capillaries continue to pour out fluid indefinitely even though the blood is diluted in cells and protein. Each additional saline injection breaks the equilibrium and causes an increment of edema in the traumatized area, but the stopping of the infusion is soon followed by a stopping of edema formation and later by absorption. Everybody is agreed that death from shock is due to anoxia and not toxemia. The saline injections do not necessarily decide between the two theoretical conceptions of the cause of shock, but they may offer a new approach to the problem.

The previously mentioned evidence indicated that the treated animals died not from shock but from the treatment. If the treatment should be a specific and infallible cure of shock, there is no proof that a patient could stand the severest treatment that might be needed for the severest shock. But even if fatal, the large saline infusions at least gain time by preserving life through the most acute shock period, and there is the possibility that an antidote to the treatment may then be easier to find than a cure of the original shock. Restoration of the normal blood composition is an obvious undertaking, either along with the saline infusion (perhaps with dilute plasma) or subsequently (perhaps with concentrated plasma). The dogs did not have the benefit of any real trials of supplementary treatment. A few small transfusions, attempted in the ultimate stage, necessarily failed. The fallacious theory of withdrawing water from the tissues by hypertonic saline injections proved acutely fatal in tests. Drugs, hormones and other possibilities suggest themselves, if it is ever necessary to use massive infusions which threaten life in uncomplicated or especially in complicated cases.

CONCLUSION

The only conclusion drawn at this stage will be of preliminary but sweeping character, namely, that shock is reversible at all stages. It has been explained that this result does not imply saving of life in

all cases, though a later paper will give examples of the reversal with quantities of fluid which are compatible with permanent recovery, in shock produced by the same and various other methods. This partial publication, leaving references and various details to be supplied later, has seemed advisable in the existing war emergency, because the experiments if confirmed may suggest clinical trials in cases of shock which are hopeless under present methods.

THE normal mode of absorption from the bowel is through its mesentery and may occur by the lymphatics or through the mesenteric radicles of the portal vein. In addition it is believed that under conditions of obstruction, transperitoneal absorption through the bowel wall itself may obtain also.

IMPROVED TECHNIC FOR BLIND NAILING OF THE NECK OF THE FEMUR

THE CRECCA-CETRULO GUIDE

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SINCE Ambroise Pare's (1530) historical report of fracture of the neck of the femur, medical science has been seeking a solution to this difficult and, as has been previously stated, "unsolved fracture."

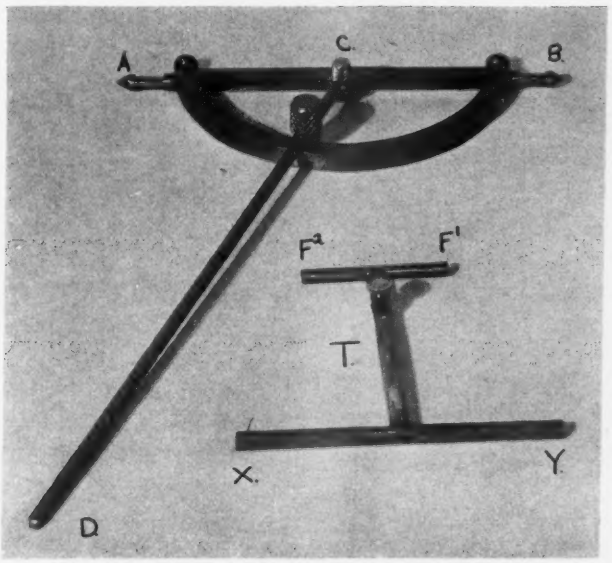

FIG. 1. The Crecca-Cetrulo guide. Calibrated axial (C-D), pivoting on protractor. Adjustable pointers (A-B) for anterior-superior-spine and symphysis pubis. Accessory part (T) which slides (X-Y) over axial rod with parallel ferrule (F^1-F^2) for $\frac{3}{32}$ pin. F^1 is set against central point of shaft about $\frac{1}{2}$ inch below inferior border (ridge) of lateral aspect of greater trochanter.

Smith-Petersen's introduction of the three flanged nail ushered in an era of ingenious approaches to this problem. Contributions among others by Sven Johanssen of Sweden (1932) and Wescott of Virginia (1932) served to improve the original technic by introducing blind nailing. Since then several types of guides for nailing have been introduced, notably, the Bailey, the Engel-May, the Groves and the Littig. Each of these has its merits but is lacking in either facility of application or in accuracy of position in all fractures.

The other guides all seek, in one means or another, to direct a Steinman pin or nail in a certain plane but fail to give a three dimensional adjustment necessary for accuracy.

The authors present a guide which is based on fixed anatomical landmarks assuring tridimensional accuracy as revealed in anterioposterior and lateral planes. The variable adjustments required for different degrees of depth and angulation are taken

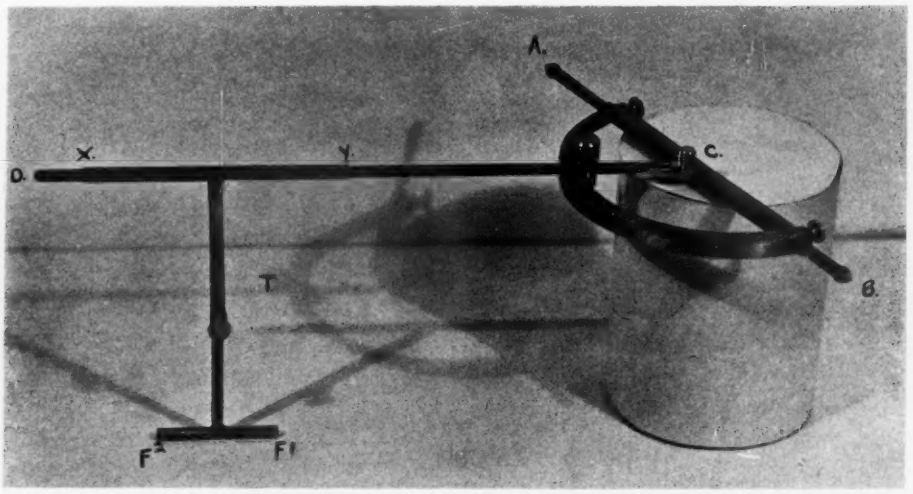

FIG. 2. Guide showing pointers (A-B), axial rod (C-D) and accessory part (T) with ferrule (F^1-F^2) and sliding casing (X-Y).

FIG. 3.

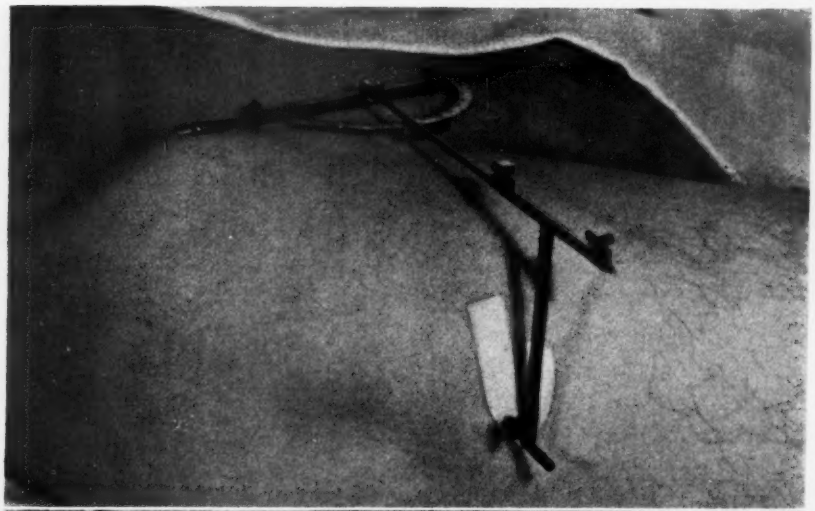

FIG. 4.

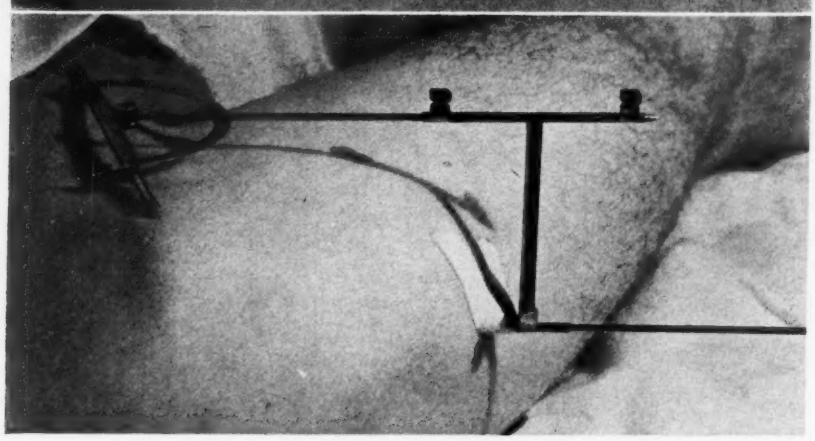

FIG. 3. Lateral view on patient showing position of guide prior to operation.
FIG. 4. Lateral view on patient showing guide in position with $\frac{3}{32}$ Steinman pin in ferrule.

into full consideration. The ease of application and adjustment of this guide insures accuracy and facilitates quick insertion of the nail.

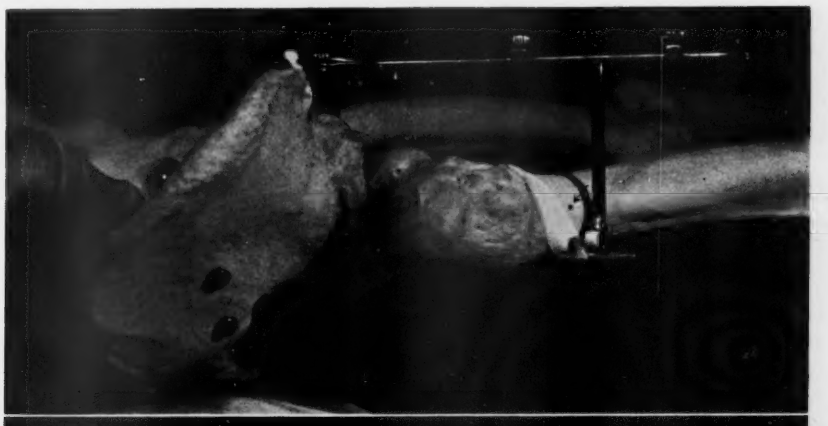

Fig. 5.

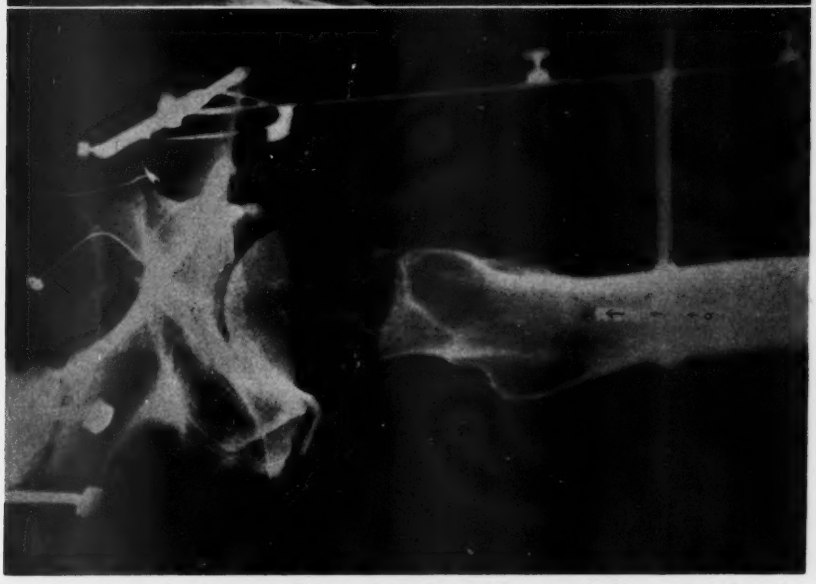

Fig. 6.

Fig. 5. Lateral view of Crecca-Cetrulo guide on skeleton showing leg parallel to floor and in internal rotation (20 degrees). Neck is on horizontal plane. The ("T") guide slides upward to position of circle.

Fig. 6. Roentgenographic lateral view of skeleton showing guide in position prior to drilling—$\frac{3}{32}$ pin. Direction of ferrule points through center of neck.

Purpose. The authors' aim is to facilitate the technical problem of inserting a Smith-Petersen (Johansson) nail under favorable and accurate operating conditions. The method presented by the authors (1) eliminates opening of the hip joint, (2) avoids possible injury to vessels, (3) insures accuracy of reduction and fixation, and (4) shortens the operating time.

Landmarks. The land marks essential for the proper application of the Crecca-Cetrulo guide are: (1) Anteriosuperior spine; (2) spine of the pubis and symphysis-pubis; (3) the inferior border (ridge) of the lateral aspect of the greater trochanter.

Principle. 1. In a normal pelvis a line (5 to 5½ inches) drawn between the anterio-superior spine and the symphysis-pubis crosses the acetabulum and, correspondingly, the head of the femur. The midpoint of this line corresponds to the central point of the head of the femur.

If instead, a line (4 to 4½ inches) from the anterio-superior spine to the spine of the pubis is used, the head of the femur is

from ½ to ¾ of an inch more medial on this same line.

2. An imaginary line (3 to 4 inches) from the midpoint of the "anteriosuperior spine–symphysis–pubis line to a point ¾ of an inch below the inferior border (ridge) of the greater trochanter represents the optimum direction for nailing.

3. The angle formed by the junction of these two lines (at a point over the head of the femur) varies between 95 and 120 degrees depending upon the amount of abduction.

4. With the leg set parallel to the floor or the table and fixed to the Hawley foot piece at 20 degree internal rotation, the neck lies on a horizontal plane. Any slight variation will be revealed by radiograph.

FIG. 7.

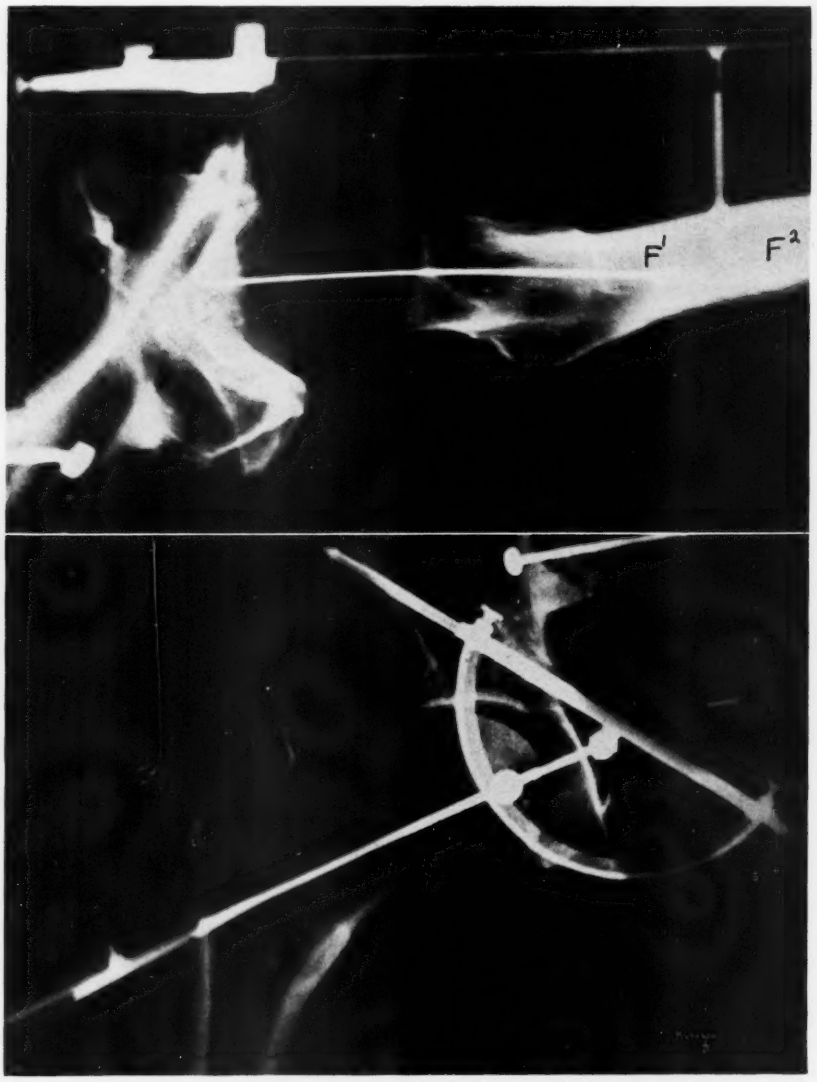

FIG. 8.

FIG. 7. Lateral view showing 3/32 pin drilled through ferrule. Note parallel plane of neck, pin and axial rod.

FIG. 8. Same as Figure 7 in anteroposterior view.

Equipment. The equipment consists of (1) a Hawley table with provision for fluoroscopy or *x*-ray; (2) canalized Smith-Petersen nail (Johansson), impactor and accessories; (3) box for sliding cassette in place; (4) drill and calibrated Steinman pin (3/32); (5) surgical set-up for simple incision and exposure, and (6) Crecca-Centrulo guide. (Figs. 1 and 2.)

Technic. This involves (1) Spinal or intravenous pentathol anesthesia; (2) placement of box for cassette underneath

patient's buttock; (3) reduction by Leadbetter technic, i.e., flexion of the thigh, traction in the axis of the thigh and internal rotation, extension and abduction of the leg. (Palm test: roentgenogram is taken to determine proper reduction.) (4) Patient's foot is strapped to Hawley table (foot piece) with *the leg in internal rotation (about 20 degrees). Leg must be parallel* to the table or floor and in fixed position. (5) surgical preparation of the field; area includes lower part of abdomen and thigh; (6) set Crecca-Cetrulo guide (Figs. 3 and 4) from anterosuperior spine to spine of pubis and fix guide in position with skin clips at both spines. Set central point of axial rod ¾ of an inch from midpoint of anterosuperior spine–pubis spine line. Set end of axial rod to cross a point ¾ of an inch below inferior border (ridge) of greater trochanter; note calibrations on axial rod; (7) fluoroscope or take roentgenogram with guide in above position. (Fig. 9.) If direction is perfect, proceed otherwise adjust guide accordingly. (8) Make a lateral incision 3 inches long, one inch above the inferior border (ridge) of the lateral aspect of the greater trochanter and 2 inches below.

Expose shaft of femur at this point, spreading fibers of tensor fascia lata and vastus lateralis. One important vessel will be encountered (this should be spread, if possible because of its value to hip joint)—the ascending branch of the lateral circumflex of the profunda on its way to the crucial anastomosis with the gluteal, deep circumflex and medical circumflex.

Fig. 9. Roentgenographic anteroposterior view of guide with pointer at pubic spine.

Fig. 10. Smith-Petersen nail, Johannson type, being driven home after use of guide.

Feel with the index finger over the anterior and posterior aspects of the femur to ascertain thickness of shaft. Now find the midpoint of shaft (¾ of an inch below the inferior ridge of trochanter) and fix accessory part of guide "T" to this point.

This is done by sliding accessory part of guide (Fig. 5) on the axial rod so that the accessory ("T") *parallels* the axial rod and the table. Then the lower end of accessory ("T") makes contact with the middle of the shaft at this point. A lateral roentgenogram of the neck with a plate between the legs will reveal the direction of ferrule of ("T"). (Fig. 6.)

(9) Drill calibrated Steinman pin through lower end of accessory ("T") paralleling calibrated axial rod through depth of head of femur. (Fig. 7.) (10) Anteroposterior and lateral roentgenograms should be taken for verification of position. (11) Insert canalized nail (Johanssen)—length equal to calibration determined above; (12) Close wound. (13) The entire procedure can be completed in about thirty to forty minutes with fluoroscope or *x*-ray. (14) The patient may be placed in a wheel chair in a few days with weight bearing started in six to ten weeks.

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SULFADIAZINE ANURIA

ITS RELIEF BY URETEROPYELOSTOMY

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THE dangers of grave drug reactions during sulfonamide therapy have been voluminously recorded and, particularly in recent literature, many instances of sulfonamide anuria have been reported.[1] In about a third of these patients the anuria was treated by forced fluid intake and often, in addition, by urinary alkalinization. In the remaining two-thirds increased fluid intake and ureteral catheterization, with or without ureteropelvic lavage, were employed. Yet approximately 30 per cent of all patients with sulfonamide anuria died in uremia, with or without other manifestations of sulfonamide ill effect.

Surgical renal decapsulation has been suggested as a method of improving urinary drainage through renal tubules occluded by acetylsulfonamide crystals but this does not relieve crystalline blockage of the pelves or ureters. Failing in achieving such relief by the ureteral catheter, there should be no delay in the establishment of free renal drainage by pyelostomy, ureterostomy or combined pyeloureterostomy. The site of upper urinary tract incision should be proximal to the uppermost obstruction. The beneficial practical application of this dictum is illustrated in the following report of a patient moribund in anuria, whose life was saved by unilateral ureteropyelostomy, etc. With unilateral restoration of renal drainage, uremia gradually disappeared and one week later free drainage of the opposite kidney was achieved by cystoscopic manipulation. While it is possible that the treatment of this patient is not unique, careful search of the literature has failed to reveal a parallel instance; our striking success in an apparently hopeless situation may suggest to and encourage others in the employment of this procedure when indicated.

CASE REPORT

W. W., age forty-seven, a white chef, was admitted to the Montclair (New Jersey) Community Hospital on April 30, 1942, complaining of severe abdominal pain which began seventy-two hours previously and during the past twenty-four hours was accompanied by chills and fever. There had been some nausea but no vomiting. The patient stated he had been coughing for several days and complained of sore throat, as well as some pain and tenderness in the right lower chest and axillary region.

During the past several years the patient had suffered gastric distress with epigastric pain several hours after eating, most severe during the winter months, and these upsets were occasionally accompanied by black stools. For this he had been under treatment by another physician whose diagnosis, said to have been confirmed by radiographic studies, had been gastric ulcer and "nervous stomach." These symptoms recurred acutely three days before present hospital admission, increasing in intensity; one black stool was passed.

In the past varicosities of the left leg had been treated by injection. More recently, severe dental infection had been treated by local drainage and by several extractions.

Upon admission to the hospital the temperature was 102.4°F., the pulse was 82, the respirations were 22 per minute and examination by one of us (J. H. F.) disclosed right lower abdominal pain which was not sharply localized. The nasopharynx was moderately injected and there were small slightly tender palpable cervical glands. There was tenderness in the right lower chest and in the right axillary region. Thoracic examination disclosed no abnormality by percussion but the breath

sounds were slightly diminished over the right lower chest area in the midaxillary line; elsewhere the breath sounds were variably harsh. There was no change in tactile fremitus. The cardiac examination revealed no abnormality. The left abdomen was soft but there was muscle spasm on the right, most marked in the right lower quadrant. There was acute tenderness in the right flank. The liver and spleen were not palpable. Urinalysis showed 3 to 4 leucocytes per high power field. The blood count was as follows: hemoglobin 92 per cent; erythrocytes 3,760,000; leucocytes 16,450; neutrophiles 78 per cent; lymphocytes 14 per cent; monocytes 8 per cent. Schilling Index: Segmented forms 62 per cent; band forms 9 per cent; young forms 7 per cent.

Despite the respiratory infection, acute appendicitis was at first suspected but within four hours after admission to the hospital the abdominal pain localized along the course of the left colon although discomfort in the right lower chest persisted. A tentative diagnosis of nasopharyngitis, pleuritis and gastrointestinal infection was made. The nasopharyngeal infection was treated by the administration of codeine and aspirin and throat sprays. In addition, on April 30th, the day of admission, the patient received an initial dose of 2 Gm. (30 gr.) of sulfadiazine which was continued in doses of 1 Gm. (15 gr. each) every three hours; this was continued until May 5th.

On May 1st, the blood count showed 16,850 leucocytes of which 77 per cent were neutrophiles; 19 per cent were lymphocytes and 4 per cent were monocytes. Schilling Index: segmented forms 55 per cent, band forms 19 per cent, young forms 3 per cent. The sulfadiazine blood level was 2.3 mg. per cent. Sulfadiazine crystals appeared in the urine within twenty-four hours after this therapy was begun but the urinalysis was otherwise normal. The patient now complained of severe pain in the right chest. There was some dullness at the right pulmonary base but no râles were heard. The diagnosis of pleurisy and localized pneumonitis was made. The fluid intake was 3,980 cc. and the urinary output was 2,040 cc. during the first twenty-four hour period in the hospital. During succeeding days an increased fluid intake was maintained chiefly by intravenous infusions of normal saline—5 per cent glucose solution.

On May 3rd, his pulmonary and abdominal condition seemed improved. Fluids were given intravenously and by mouth to the extent of 3,100 cc. but the urinary output dropped to 950 cc. Sulfadiazine blood level was 2.7 mg. per cent.

On May 4th, the fluid intake was 3,150 cc. and the urine output was 1,820 cc. Sulfadiazine crystals continued present in the urine. The highest temperature on this day was 100°F. A roentgenographic study of the chest showed clear pulmonic fields.

On May 5th, the sixth day of the illness, the fluid intake was 2,200 cc. The patient complained of pain in the left loin and difficulty in urination. Later in the day he could not void at all. He was catheterized and 180 cc. of turbid urine was recovered. Sulfadiazine was discontinued; a total of 465 gr. (31 Gm) had been administered during the six-day period.

The patient became anuric, nauseated, distended and vomited repeatedly. On May 7th, the urethral catheter returned nothing. Marked edema of the face developed and his condition rapidly became exceedingly critical. On the afternoon of May 7th, one of us (M. F. C.) was called in consultation. The diagnosis of sulfadiazine anuria with advanced uremia was made and immediate ureteral catheterization was advised. That morning the patient's reaction was sluggish and that evening he was unresponsive and essentially moribund. A plain *x*-ray of the urinary tract showed no shadows indicative of calculus.

That night cystoscopy was carried out under light nitrous-oxide-oxygen analgesia (M. F. C.). The bladder was found empty; the bladder picture was that of generalized congestive cystitis with the bladder floor deeply covered with acetylsulfadiazine crystals. Numerous crystalline clumps were adherent to the bladder wall and dome. Projecting from each ureteral orifice was a large dense crystalline cluster which, on the left side, could not be budged. On the right side, the extruding crystalline mass was broken away and, with great difficulty and while a steady stream of sterile water was being injected through the ureteral catheter, it was finally possible to wash away enough crystalline débris from the lower ureter to permit passage of the catheter 1 cm. up the duct. Higher than this it would not go. For the benefit of those who have never attempted to pass a ureteral catheter up a ureter firmly blocked with acetylsulfonamide

crystals, it should be noted that as the catheter breaks down the larger crystalline clusters in the duct, the pulverized particles become even more densely packed and offer even greater resistance. The purpose of the continuous irrigation of the ureteral catheter, though fruitless in this case, was to wash away this crystalline débris as it was broken up within the ureter.

Because of the patient's perilous condition he was immediately sent to the operating room for direct drainage of his right kidney pelvis. There was no succinct reason for selecting the right kidney over the left except that he had more recently been suffering pain attributable to the right.

Right ureteropyelostomy (M. F. C.; J. H. F. assisting). Under nitrous-oxide-oxygen analgesia the lower pole of the right kidney was exposed through a curved loin incision, and was mobilized sufficient to permit visualization of the upper ureter and adjacent renal pelvis. The ureter was found tightly packed with acetysulfadiazine crystals, giving it a pipestem effect. A longitudinal incision 1.5 cm. long was made in the upper ureter at the junction of the renal pelvis; this liberated a small amount of extremely cloudy urine and some crystals. A No. 20 French two-eye catheter was passed into the kidney pelvis, the pelvis was well irrigated with saline, and the catheter was fastened by one fine chromic catgut suture to the ureteral muscularis and sheath. Decapsulation of the greatly congested kidney was performed without further mobilization of the organ from its bed. Three cigarette drains were carried down to the ureteropelvic opening and the muscle and fascia of the loin wall were approximated with a double layer of No. 2 continuous chromic gut suture. The skin and external fascia were closed with interrupted deep dermal sutures. By an additional suture the catheter was anchored firmly to the skin margin.

Postoperative an intravenous infusion of 1,500 cc. of saline-glucose solution was given. Nausea and vomiting stopped. Strikingly, in the first six hours postoperatively, the right kidney excreted 1,450 cc. of urine and the following twelve hours excreted 2,500 cc. more; subsequently a normal fluid balance was maintained. Gradually, the uremic manifestations disappeared and forty-eight hours postoperatively the patient was thoroughly alert. The day following operation the blood sugar estimation was 107 mg. per 100 cc., nonprotein nitrogen 62.8 mg., chlorides 462 mg., and carbon dioxide combining power 54 volumes per cent.

Two days postoperatively the patient complained of vesical fullness with inability to urinate. Catheterization withdrew 180 cc. of dark brown urine; the catheter was then maintained indwelling for three days.

On May 10th, three days postoperatively, thrombophlebitis of the left leg was evident. This responded rapidly to immobilization and hot wet dressings; sodium thiosulfate was given intravenously (10 cc. of a 10 per cent solution). Yet abdominal distention and diarrhea caused the patient his chief postoperative distress.

As the urinary excretion through the indwelling catheter increased and the right renal drainage tube maintained approximately its former output, it was believed that left ureteral drainage had spontaneously been established. In order to make sure of this and to estimate left renal function, cystoscopy was again performed (M. F. C.). It was now possible to pass catheter to the left kidney pelvis and, by irrigation, remove a large amount of acetylsulfadiazine crystal débris. The right ureter was likewise catheterized and lavaged. Marked edema of the prostate and vesical outlet explained the patient's urinary difficulty; the urethral catheter was left indwelling for one week following the cystoscopy. Also following cystoscopy the output from the catheter in the right kidney dropped considerably as the left kidney resumed normal activity. The following day the right drainage tube was removed. Urinary drainage persisted through the wound for two weeks.

Two days after the second cystoscopy and, appearing with sharp onset, bronchopneumonia involved the right lower lung. This was successfully treated by Dr. George Henshaw who declined to employ sulfonamide therapy because of the patient's recent experience. On May 23rd, a mild secondary pneumonic process involved both pulmonary apices, more marked on the left. He was discharged from the hospital on June 1st with a clear chest and notably free of intestinal disturbance. A subsequent complete gastrointestinal radiographic study showed no abnormality. For several weeks following his discharge from the hospital, a Staphylococcus aureus urinary infection per-

sisted but was eventually eradicated by mandelic acid therapy as evidenced by two sterile cultures. An excretory urographic study made three months later showed no abnormality except a slight right ureteral irregularity just below the pelvic outlet.

REMARKS

Although we appreciate that in certain instances acetylsulfonamide anuria may result solely from occlusion of the renal tubules, clinical and postmortem observations suggest that ureteral and pelvic blockage by crystal deposit is more often fatal and, therefore, merits the greater consideration. When, as in our case, ureteral catheterization is technically impossible, no time should be lost in establishing free urinary drainage by opening the renal pelvis or the adjacent upper ureter and well above any crystalline obstruction. By employing this procedure, the pelvis can be evacuated of crystals, restoration of renal function is likely to be prompt, the operation does not require extensive renal mobilization, and in our opinion is definitely less traumatic to the kidney, already severely injured by obstruction, than nephrostomy—a point of special physiologic importance in all types of anuria.

The appearance of acetylsulfonamide crystals in the urine despite a relatively low blood concentration of the sulfadiazine confirms observations of others that there is little relation between the dose administered and the deposition of crystals. It is notable that, as in the case here reported, the radiographic studies are likely to be of little aid as the acetylsulfonamide crystals are rarely demonstrable by this means. In retrospect, it is possible that the alkalinization of the urine upon the early appearance of acetylsulfadiazine crystals in the urine might have prevented formation of subsequent crystalline masses but this is debatable. Similarly, earlier withdrawal of the drug might have prevented complete bilateral ureteral blockage but the medication was not stopped because the drug was combatting the initial disease so successfully. Moreover, the ultimate obstructive complication could not be foreseen.

SUMMARY

A case of sulfadiazine anuria is reported in which the establishment of urinary drainage by ureteral catheterization having failed in our hands, for technical reasons, the life of the moribund patient was saved by unilateral ureteropyelostomy. The restoration of isolateral renal function was immediate. When anuria occurs during sulfonamide therapy and conservative noninstrumental and instrumental treatment is fruitless within forty-eight hours, surgical drainage of at least one kidney should be instituted without delay. This offers the remaining hope for saving the patient's life, for, with the return to unilateral renal function uremia disappears, and at a suitable subsequent time—preferably within seven to ten days—cystoscopic efforts to unblock the opposite upper urinary channels can be made. If the unilateral operation fails to promote free urinary drainage within twelve to twenty-four hours, promptly and surgically drain the opposite kidney.

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TECHNIC FOR THE REPAIR OF "BASEBALL" FINGER

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IN repairing "baseball" finger of the type in which the bony attachment of the extensor digitorum communis tendon is avulsed, there are several factors which predispose to poor end results. A satisfactorily functioning finger is dependent upon bony union and avoidance of scar tissue which would limit joint motion. The incision must be adequate to freshen and reduce the bone fragment, and the fragments must be held completely immobile during the healing period. On the other hand, the proximity of the nail-bed which is vulnerable to slight trauma, a terminal blood supply, and inelasticity of the skin making it susceptible to necrosis, limit the size of the incision and the amount of dissection. To meet these conditions the following technic has been developed:

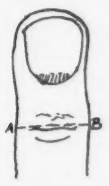

FIG. 1.

FIG. 2a.

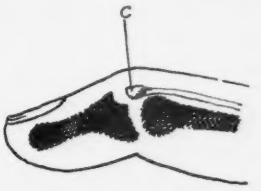

FIG. 2b.

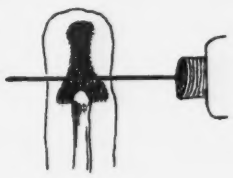

FIG. 3.

FIG. 1. A-B shows line of incision.

FIG. 2A. C shows avulsed fragment to be freed (anteroposterior view). B same as A (lateral view).

FIG. 3. Needle transfixing base of terminal phalanx, passing through skin and subcutaneous tissue.

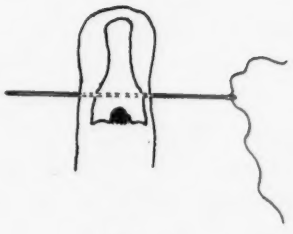

FIG. 4.

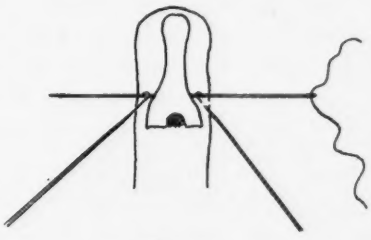

FIG. 5.

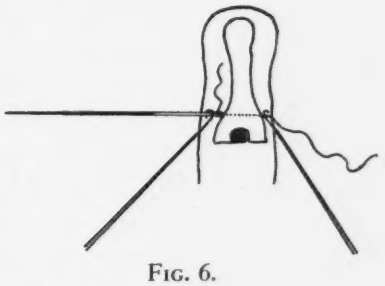

FIG. 6.

FIG. 4. Needle threaded after drill has been disconnected.

FIG. 5. Needle engaged by hooks which have been passed through transverse incision.

FIG. 6. Thread caught and pulled into wound with hooks, first one then the other, as needle is drawn through by assistant.

FIG. 7A.

FIG. 7B.

FIG. 8.

FIG. 7A. Tendon sutured close to bony fragment (anteroposterior view;) B (lateral view).

FIG. 8. Wound closed.

A transverse incision is made on the dorsum of the finger corresponding to the prominent distal interphalangeal crease

and the flaps dissected in order to expose the extensor tendon with its attachment to fractured bone fragment. The fragment is

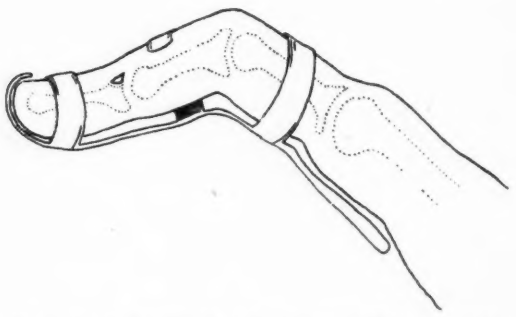

Fig. 9. Position of finger immobilized with malleable splint.

freed from surrounding adherent tissue and its fracture surface freshened, as well as the surface of the base of the distal phalanx into which it inserts. An ordinary darning needle, the diameter of a Keith needle, guided by a Kirschner drill, is then used to transfix the base of the distal phalanx. The insertion is made through the skin, subcutaneous tissue and bone without additional incisions. The drill is detached and the needle threaded with the nonabsorbable suture, cotton or silk to be employed. Through the wound, a hook resembling a dural hook, but firmer, is passed distally on either side of the terminal phalanx beneath the periosteum, hugging the bone until the needle is engaged. Then as the assistant slowly draws the needle through, the suture material is caught and brought down so that the free ends emerge at the incision site. Sutures are then taken in the extensor tendon close to the fragment and the ends tied, with the finger in hyperextension and the bone fragment fitting snugly into its slot. The wound is closed and the finger is splinted with the terminal phalanx in extension, and the proximal interphalangeal and metacarpophalangeal joints in the position of flexion corresponding to optimal function. For this purpose a well fitting malleable splint is satisfactory. A blood pressure cuff kept between 220 and 280 mm. of mercury is used as a tourniquet on the arm, and sodium pentothal intravenously is given for anesthesia. For draping after the hand has been prepared, a sterile cotton glove with finger to be operated upon cut out, is useful. Immobilization is maintained for three to four weeks, following which controlled passive and active motion are instituted. The steps in the operation are illustrated in the accompanying diagrams.

SUMMARY

The technic of performing this operation is, to my knowledge, new. It has been used in several cases with satisfactory results, assuring one of normal functioning joints, smoothly gliding tendon and bony union, as well as eliminating the less serious complications of nail-bed damage and sloughing wounds. Through simply a transverse incision it has been possible to obtain sufficient exposure, yet with a minimum of dissection. It has the additional advantage of being applicable to the repair of digital flexor and extensor tendons shorn at their insertions, when no soft tissue remains for suture. By freshening the site of bony attachment and making a trap-door for insertion, the tendon may be sutured and held in place, using this technic.

I am indebted to Dr. Robert L. Preston for his guidance in the development of this procedure.

SKIN GRAFTING*

A NEW METHOD BASED ON THE PRINCIPLES OF TISSUE CULTURE

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WHILE skin grafting has progressed technically a long way in the past decade or more, the fact still remains that the usual methods have not always proved satisfactory. This is especially true in areas where normal physiologic movements, such as respiratory activity of the chest wall, interfere with the "take" of a graft. Similarly, irregular, uneven, angulated regions like the nose or ear occasion particular difficulties in obtaining successful end results, because of the necessity of stitching the graft, and of using pressure dressings which interfere with the blood supply all too frequently.

As a result of my experience in assisting at an operation for skin grafting in which considerable difficulty was encountered because of bleeding caused by stitching the graft, I began to wonder whether the same principles which were successful in growing cells outside the body in tissue culture might not be applicable to skin grafting by providing physiologically, adhesion of the graft to its bed through the use of plasma. In tissue culture growth is obtained by supplying (1) a suitable surface for the cells to grow on through the use of coagulated plasma, and (2) adequate nutrition through a medium made up of embryonic tissue extract and a buffered salt solution (Tyrode's solution).[1] The most satisfactory cell growth is obtained in tissue culture by the use of homologous plasma and tissue extract. The plasma is heparinized when obtained to prevent its coagulation until it comes into contact with the tissue extract and salt mixture at the time of planting the culture. With such contact the fibrin is precipitated and a delicate clot formed which serves to fix the tiny fragment of tissue, and thus permits cell growth to take place. In such cultures, it has been shown repeatedly that fibroblastic proliferation normally begins within a matter of a few hours.

Based on the principles just outlined, experimental grafts were made on a series of twelve rats, with most gratifying results. The technic employed in this study is outlined in the following paragraphs. To create the most favorable conditions the plasma and cell extracts used in this work were not only homologous, but actually autogenous in each instance. Further studies are in progress to determine whether such refinements of technic are necessary. As will be apparent from the discussion, in any actual clinical case it is just about as practical a procedure to use the patient's own plasma and cell extract as a stock preparation.

PROCEDURE

Blood is taken from the rat's heart and mixed in the proportion of 1 mg. of heparin to each 5 cc. of blood. This is then centrifuged, the plasma pipetted off and kept in the refrigerator until needed. Tyrode's buffered salt solution is added to the packed red and white cells volumetrically, in the proportion of 5 parts Tyrode's solution to 1 part red cells. This mixture is shaken vigorously and allowed to stand at room temperature for one half hour. It is then centrifuged and the supernatant fluid removed. This supernatant fluid will be referred to subsequently as "extract."

The rat is shaved over the site elected for the experimental graft. Areas over the chest wall and the nape of the neck were chosen as representing the sites least likely to succeed because of the movements of the

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chest wall and animal's head. The skin in these areas is removed and a sterile dressing applied to prevent infection from developing. At the end of four days healthy granulation tissue has formed at the base of the denuded areas and the animals are considered ready for actual grafting procedure.

Skin grafts of full thickness are removed from the abdomen or sides of the animals under the usual aseptic precautions. Excessive fat is carefully removed from the undersurface of the graft, which is then trimmed to fit the denuded area or to cover its central part. The graft site is then painted with a drop or two of the heparinized plasma by means of a sterile fine camel's hair brush. Similarly, the undersurface of the graft is painted with "extract." The graft is then placed on the denuded skin area and carefully fitted by means of forceps.

To produce fixation of the grafts through coagulation of the thin layer of plasma, hot compresses (at about 50°C.) are applied, using gentle pressure. These compresses are renewed frequently and maintained for between five and ten minutes. No dressings except one thickness of vaseline gauze to protect the tissue from infection are used. Stitches are not necessary whether the graft is a few millimeters or a few centimeters in size. A cork ring is placed over the gauze to protect the operative field from trauma and this is held in place by adhesive tape. At the end of twenty-four hours the site of the graft is inspected and any serum which has accumulated around the edges gently wiped off, and the protective covering reapplied for from forty-eight hours to seven days depending upon the size and the location of the graft. Within forty-eight hours the graft has become vascularized and assumes a normal, healthy color. Care is necessary in such animal experimentation to prevent too great pressure in the application of the ring, thus impeding venous circulation and causing edema. When the technic is properly carried out the procedure has resulted in 100 per cent takes. Obviously, minor modifications of the method may be introduced depending upon many factors. If the graft is small enough or in a site little subject to trauma, plasma alone is quite satisfactory, although the use of the "extract" appears to give somewhat better fixation of the graft. The graft does not adhere so well if first bathed in saline and this procedure, so frequently used in skin grafting, is entirely dispensed with. After the graft is fixed its immobility is always tested by producing gentle traction on it with forceps. It is invariably quite adherent, but where no plasma or hot compresses are used it slides under the slightest traction.

As a result of the success of these initial animal experiments and with the co-operation of the members of the surgical staff of Temple University Hospital, the method is being utilized successfully in clinical cases. These will be reported at a later date. Because of the tremendous number of casualties in this present global conflict which will require skin grafting as a result of their injuries, it was believed that this new method should be made available to the medical profession as promptly as possible.

SUMMARY

A new method for skin grafting is presented, depending upon the principles of tissue culture, namely, the fixation of the graft by means of a thin coagulum of autogenous plasma. No stitches or pressure dressings are necessary.

Besides the clinical work, further experimental animal work is in progress to simplify the method and broaden its application.

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Case Reports

REIDEL'S THYROIDITIS

REPORT OF TWO CASES

THOMAS C. CASE, M.D.

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THE purpose of this communication is to emphasize the importance of the careful consideration of thyroid disease (Reidel's Struma) in patients who appear neurotic, bordering on a psychoses, and who in spite of rational medical therapy over a period of time become progressively worse. Of 800 cases of hyperthyroidism studied by Foss and Jackson mental disorders were found in two cases. Parker found that less than 2 per cent of patients with exophthalmic goiter presented mental derangements. In view of the infrequent association of these two conditions and the presence of the neurosis, or even symptoms simulating psychoses, in the two cases of chronic thyroiditis seen within a short period of time, it was thought interesting enough to make this report. The diagnosis became apparent only after careful daily observation.

CASE REPORTS

CASE 1. B. D. age thirty-seven, a white female secretary, complained of extreme nervousness with attacks of hysteria, choking sensation and slight cough, pain and swelling of thyroid since February 27, 1942, and light temperature.

In her past history she had had her tonsils and adenoids removed in 1922, appendectomy and resection of ovary in 1926 and cholecystectomy in 1929. A fistula of the rectum was operated upon in 1929 and an operation for osteomyelitis of the left femur was performed in 1933. She has had repeated attacks of sore throats and sinusitis in the past year.

For the past two years she complained of ill health almost continuously. She felt nervous, irritable and would become hysterical without apparent reason. She complained of palpitation and inability to gain weight in spite of complete rest, a high caloric diet and the administration of tonics.

At no time did she notice any swelling in her neck until February 27, 1942 at which time examination revealed a tender mass in the right lobe of the thyroid. The appearance of the swelling was accompanied by cough and choking sensation with persistence of local pain which later radiated to the right ear and right side of the neck. The temperature would range from 99° to 100.5°F. and the swelling and tenderness extended across the isthmus to the left lobe within a period of one week. She also had profuse sweats, attacks of tachycardia and began to lose weight. She was kept under observation for one month during which time the swelling and tenderness would migrate from one lobe to the other.

The patient appeared to be somewhat emaciated and looked chronically ill. While the eyes did not reveal exopthalmus there was present a definite stare with markedly dilated pupils. Examination of the neck revealed a uniform enlargement of both lobes of the thyroid and isthmus. The right lobe was slightly larger than the left one. Tenderness of the gland was present at all times, however, during the period of observation in the hospital as the tenderness disappeared the gland became quite hard and firm and just before operation the entire gland was stony hard. There were no other palpable glands in the neck. The mucous membranes of the nose and throat were red and congested.

The lungs and heart were normal. The patient's blood pressure was 90/170. The abdomen showed nothing abnormal. On February 28th the basal metabolic rate was plus 1, on March 13th it was plus 38 and on March 24th it was plus 20. There were 3,750,000 red blood cells, 86 per cent hemoglobin, 7,750 white blood cells, 57 polymorphonuclears, 33 lymphocytes, sugar 89 and cholesterol 150.

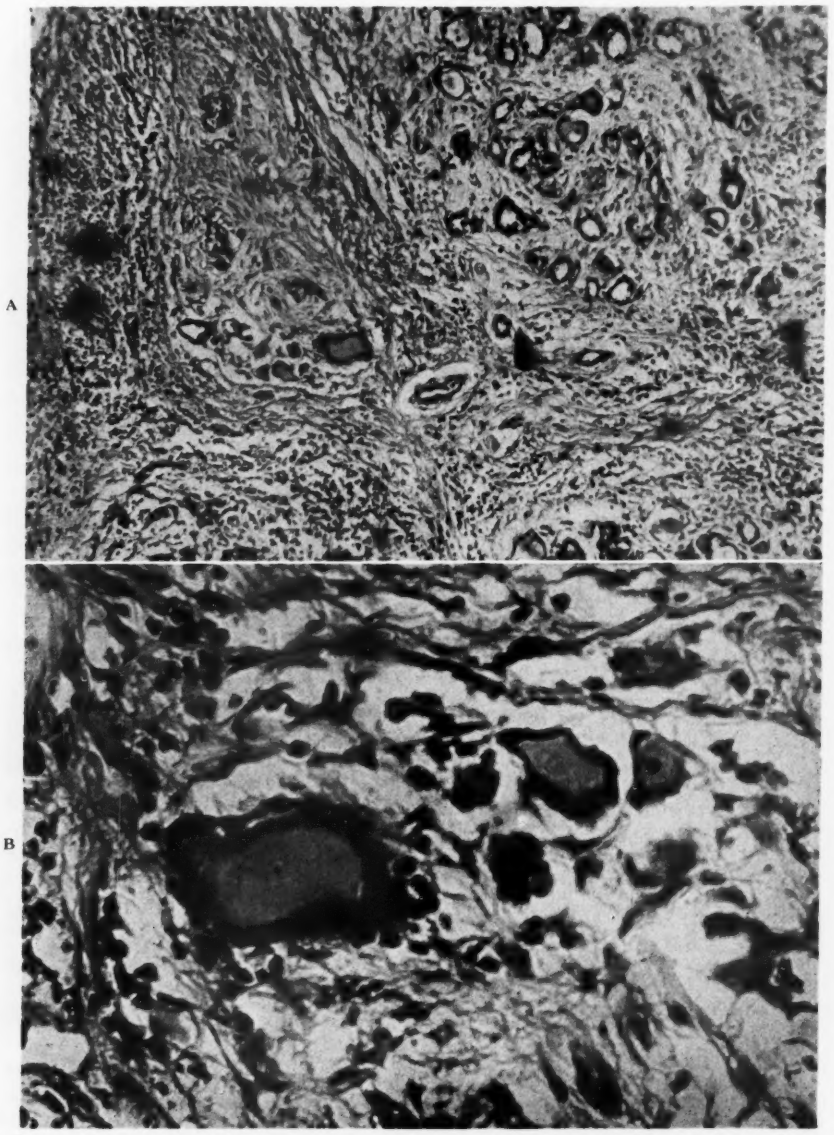

FIG. 1. Case 1. Low and high microscopic studies of slides of thyroid gland. Low power magnified 100 times and the high power 400 times.

The patient was admitted to St. Vincent's Hospital on March 12, 1942. Lugol's solution and sedation were continued. The general condition improved and she was operated upon April 2, 1942, under cyclopropane anesthesia.

Upon exposing the thyroid it was found to be very hard in consistency, intimately adherent to surrounding tissue. The right lobe was moderately enlarged. The isthmus was quite enlarged and the left lobe was about three times normal size. The left lobe was actually stony hard in consistency. One small adenoma could be felt in the right lobe.

A low collar incision was made, the thyroid was exposed and a subtotal resection of both lobes was done. The isthmus and medial portions of both lobes were very adherent to the trachea. Gland tissue was grayish in color and cut like cartilage. Bleeding points were all controlled and resection was done after division of the isthmus, leaving the posterior portion

of both lobes intact. A drain was placed over both resected lobes and the neck was closed in layers. Sulfanilamide was applied into the wound.

gray, homogeneous appearance. One of the pieces contained a cyst measuring 6 mm. in diameter.

There was a considerable increase in connec-

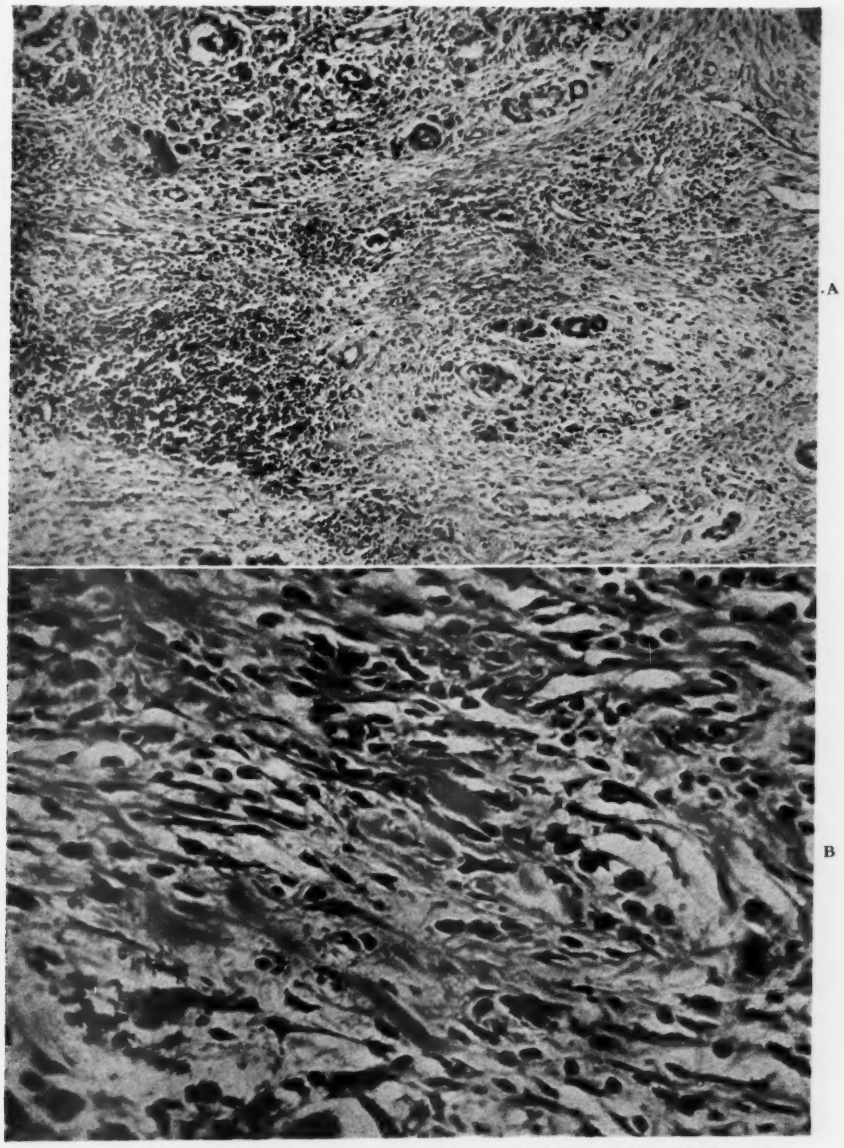

FIG. 2. Case II. Low and high microscopic studies of slides of thyroid gland. Low power magnified 100 times and the high power 400 times.

The postoperative course was uneventful. The wound healed by primary union and the patient was completely relieved of her symptoms when she left the hospital on her twelfth postoperative day. To date, October 15, 1942, she has gained 15 pounds in weight and has no complaints.

The pathological report by Dr. A. Rottino revealed the following: The specimen consisted of four pieces of firm thyroid tissue of varying sizes all together weighing 20 Gm. On section the cut surface presented a smooth,

tive tissue between the alveoli. In the interstitial tissue one also noted considerable lymphocytic infiltration. In some portions of the gland there was almost complete replacement of alveoli by inflammatory tissue. In an occasional area, tubercle-like lesions were seen composed of giant cells, centrally placed, surrounded by epitheloid cells. In other areas one found granulomatous lesions in which polymorphonuclear leucocytes were found surrounded by larger epitheloid-like cells.

In thyroid glands exhibiting chronic inflammation one at times finds a pseudotuberculous picture. The demonstration of tubercle bacilli is usually impossible. This lesion probably was in the nature of a foreign body reaction, the foreign body being the products of disintegration of colloid.

Case II. E. B., age 50, a white female housewife, complained of a mass in her neck, nervousness, a loss of 20 pounds in five weeks, weakness, cough, and an intermittent temperature for five weeks. The family history was negative.

For the past year the patient complained of repeated sore throats, painful swelling of neck and increasing nervousness. Two weeks previous to admission to the hospital she developed progressive mental confusion, incoherence in speech and flight of ideas. For five weeks before hospitalization she felt she had temperature at some time during the day. The swelling of the neck became quite apparent about one year ago. The size of the swelling would vary and as time went by she noticed an increase in size and tenderness of the mass (thyroid).

The patient appeared emaciated, almost cachectic. There was a nodular enlargement of both lobes and the isthmus of the thyroid. The gland was about four times the size of the normal gland. The right lobe was larger than the left. The tumor was stony hard and appeared to be adherent at several points to the surrounding tissue. It was tender on palpation. No nodes were palpable. The preoperative diagnosis was either malignancy of the thyroid or chronic thyroiditis. The lungs were normal. An electrocardiogram revealed myocardial damage. Blood pressure was 170/90, and the basal metabolic rate plus 19. The blood picture essentially negative.

On September 1, 1942, the patient was operated upon under cyclopropane anesthesia. Upon opening the neck the thyroid was found to be enlarged to about three times its normal size, the right lobe being somewhat larger than the left. The right lobe contained numerous nodules simulating adenomas. The consistency of the entire gland was stony hard in character. There was also present a considerable amount of fibrinous exudate over the entire gland and numerous old and recent adhesions made the gland adherent to surrounding tissue, including the trachea. The condition was one typical of chronic thyroiditis. Carcinoma had to be excluded.

A transverse incision was made overlying the thyroid. Ribbon muscles were cut and the thyroid gland exposed. There was remarkably little bleeding and a subtotal thyroidectomy was performed. The wound was drained and closed in layers, using chromic gut for muscle and dermal for the skin. Sulphanilamide was applied in the wound.

The postoperative diagnosis was chronic thyroiditis (Riedel's).

The pathological report by Dr. A. Rottino was the following: The specimen consisted of two lobes of thyroid gland weighing 40 Gm. One of the lobes measured 5 by 3½ by 1½ cm. Its surface was covered with a thin transparent capsule. On section the gland presented a peculiar homogeneous, pale surface with small areas of glairy, brown colored patches scattered about. The second lobe was smaller measuring 3 by 3½ by 1 cm. Its capsule was somewhat shaggy. On section it presented the same pale homogeneous surface with nodules brown in color, measuring as much as ½ cm. in diameter.

On section the thyroid gland was found very much altered by a chronic inflammatory process. There was a marked increase in fibrous tissue throughout. There was also diffuse dense infiltration with lymphocytes. The thyroid lobules appeared as irregular nodules of varying sizes surrounded by a thick fibrous wall and composed of acini, small in size and lined by cuboidal epithelium and filled with densely staining colloid.

The postoperative course was uneventful and the wound healed by primary union. The patient was discharged after ten days with complete relief of symptoms. To date, October 15, 1942, she has gained 8 pounds and has no complaints. *Diagnosis:* chronic thyroiditis.

REMARKS

As stated previously the association of extreme neurosis or phychosis with most thyroid diseases is not frequent. I believe that in the cases herein reported the mental reactions were probably of the toxic exhaustion type. Toxic exhaustive psychoses have been found usually in cases of thyrotoxicosis due to either exophthalmic or adenomatous goiter, however, the history has usually been short and rapid improvement followed medical treatment. In the two cases herein reported medical treatment did not help. Although the

toxicosis is of thyroid origin in the exophthalmic, adenomatous, and in the cases with thyroditis, in the latter, there is probably the production of an active toxin while in the other two conditions it may simply be a thyroid disfunction.

The etiology of this condition is not definite. Focal infection has been considered a possible cause and in both the cases reported there have been definite foci of infection in the upper respiratory tract, sinusitis and throat infection in one and repeated sore throats in the other. Plummer has considered tuberculosis as a possible cause and Meeker has mentioned the possibility of a relationship between remnants of the postbronchial body and Reidel's Struma.

In making the diagnosis of Reidel's disease I believe the history is very important. Both patients complained of nervous manifestation over a period of time with some cough and choking sensation. The condition would become improved temporarily without medication; however, as the process progressed the nervous manifestation would become aggravated to the point where the patients appeared to be in a continuous state of hysteria. There was progressive loss of weight in both cases and at the time of operation they appeared to be chronically ill. The basal metabolic rate in both cases was somewhat elevated. Locally of course there is the enlargement of the thyroid, stony hard in character, with or without tenderness all depending upon the activity of the process at the time of examination. At one time the right lobe in Cases 1 was so extremely tender I thought the patient might be developing a localized abscess in the gland. This, of course, was an acute exacerbation of the chronic process.

In making a differential diagnosis, one has to consider principally toxic adenomas, malignancy of the thyroid and Hashimoto's disease, and other conditions to be considered are infectious thyroiditis, tuberculosis, syphilis and phlegmon of thyroid.

In malignancy of the thyroid, the patient is usually over forty-five years of age and gives a history of pre-existing adenoma of the thyroid. The skin and cervical glands are usually involved in malignancy and not with Reidel's thyroiditis. Pain is more pronounced with malignancy.

In toxic adenoma one has the marked elevation of the metabolic rate and the symptoms that go with it. Locally, there is usually the circumscribed tumor mass which is not stony hard in consistency and not tender to palpation.

In Hashimoto's disease, there is a tendency to myxedema with a uniform enlargement of the gland which is not stony hard on palpation. Hashimoto's disease responds to radium while Reidel's disease does not as a rule.

The treatment of Reidel's Struma is primarily surgical. Relief of both local and constitutional symptoms are obtained immediately after operation.

SUMMARY

1. Two cases of Reidel's Struma are herein reported.

2. In both cases nervous manifestations were very marked, and when present with thyroid enlargement of stony hardness one should consider Reidel's Struma.

3. Surgery afforded immediate relief in both cases.

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BILATERAL RUPTURE OF QUADRICEPS FEMORIS TENDONS WITH SIX-YEAR INTERVAL BETWEEN INJURIES

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COMPLETE rupture of the quadriceps femoris tendon is a relatively rare traumatic lesion. Conway,[1] in 1940, reported only five cases in five years in an active metropolitan hospital (St. Vincent's). Carlucci,[2] in 1934, found only four cases at Bellevue in the preceding ten years; during the same time there were 318 fractures of the patella in the same hospital. Sonnenshine[3] reported four cases of ruptured quadriceps tendon to fifty-one cases of fractured patella in five years at the Harlem Hospital. Meyerding,[4] in 1935, reported nine cases in ten years at the Mayo Clinic.

Bilateral rupture of the quadriceps tendons are even more rare. Cases have been reported by Meyerding,[5] Frey,[6] Sonnenshine,[3] Milne,[7] Chichester,[8] Woodbridge,[9] Kelly[10] and James.[11] In all of these cases the second rupture occurred either when the patient attempted to rise after the first injury or within the course of a few days. In the case herewith reported there was a period of six years between the two ruptures. The first rupture in this case was not repaired and the second was, so that an interesting comparison between an old unrepaired rupture and a recent repaired one is presented in the same patient.

Extension of the leg at the knee is produced by the action of the quadriceps muscle. The quadriceps muscle is composed of the rectus femoris and the three vasti muscles, the vastus medialis, the vastus lateralis and the vastus intermedius. The tendons of these muscles converge into a common tendon, the quadriceps tendon. This common tendon is inserted into the tibial tubercle and contains the patella as a sesamoid bone. The portion of the tendon inserted into the proximal or superior margin of the patella is known as the quadriceps tendon, and the portion extending from the distal or lower margin of the patella and anchoring it to the tibial tubercle is known as the patellar ligament or patellar tendon.

Complete rupture of the quadriceps tendon produces a prompt and marked disability, as active extension of the leg at the knee is immediately lost. This results in inability to walk, and medical attention is usually sought at once.

If the patient is seen shortly after the injury, the diagnosis should not be missed. The nature of the accident will give a clue to the injury, the same type of accident that causes a fracture of the patella being the usual one, that is, a sudden violent contraction of the quadriceps muscle while the knee joint is hyperflexed. This usually occurs in a misstep or a sudden attempt to regain one's balance. Very rarely rupture of the quadriceps may occur from a direct blow.

Pain, inability actively to extend the leg, and a sulcus above the patella, where the tendon has separated and retracted are immediate cardinal signs of this injury. In a complete tear, the condyles of the femur can be readily felt and a normal easily movable patella can usually be palpated. Later these signs may be obscured by the hemarthrosis and swelling, which occurs in the course of a few hours. Tenderness in the region of the injury will be a constant finding. *X*-rays should be taken to rule out fracture of patella or other fractures about the knee joint.

Etiology. Factors which may cause a tear or rupture of muscle or tendon as listed by Gilcreest[12] are: (1) Senility; (2) patho-

logical changes, such as, arthritis, myositis, acute infectious disease, arteriosclerosis, syphilis, tuberculosis, neoplasm; (3) physiologic predisposition; (4) occupation; (5) fatigue, and (6) trauma which is either direct or indirect.

It would seem from cases of bilateral rupture that some intrinsic weakness in the tendon or its attachment was one of the most important factors.

Fig. 1. Fig. 2.

Fig. 3. Fig. 4.

Fig. 1. Shows scar three months after repair on right knee, and shows on left knee how fingers can be introduced behind patella through old rupture of quadriceps.

Fig. 2. Lateral view, showing how fingers can be introduced behind patella through old tear of quadriceps.

Fig. 3. Showing degree of extension of repaired quadriceps tendon three months after operation.

Fig. 4. Showing degree of flexion three months after repair of quadriceps.

The incidence of quadriceps rupture is greatest in the age group of fifty to seventy years, and is somewhat more common in males.

FIG. 5. Showing lack of complete extension following unrepaired rupture of quadriceps tendon and depression above patella.

FIG. 6. *X*-ray, anteroposterior view of right knee joint; recent rupture of quadriceps tendon.

FIG. 7. *X*-ray, lateral view of right knee joint with recent rupture of quadriceps tendon, showing intact patella.

The treatment of complete rupture of the quadriceps tendon is by surgical suture of the tendon. The incision technic and type of suture material used vary considerably, but the principle of prompt suture of the torn tendon and its lateral expansions, with splinting in the extended position is common to all. This case illustrated well the necessity for open operation.

FIG. 8. *X*-ray, anteroposterior view of left knee joint; old rupture of quadriceps tendon.

FIG. 9. *X*-ray, lateral view of left knee joint; old rupture of quadriceps tendon; patella slightly lower than on right.

CASE REPORT

The patient, C. G., a white female of forty-six, who was working as a housekeeper, caught her left heel in a torn hem in her skirt, falling heavily and severely injuring her left knee. There was deformity of the knee, extension was immediately lost, and the patient stated that the knee cap was displaced downward. The attending physician made a diagnosis of dislocation of the knee joint and reduced the dislocation. She was removed to the hospital in an ambulance and on admission *x*-rays were taken, which showed no bony injury. The admission diagnosis was dislocation of left knee and rupture of quadriceps tendon. The knee was not dislocated on admission to the hospital. The patient refused operative repair of the injury, and the leg was placed in a posterior splint and the patient put to bed. On June 15, 1936, six weeks after the injury, the splint was removed, and the patient was allowed out of bed. During the next two weeks she got about on crutches, and on June 30, 1936, she was discharged from the hospital walking with a cane. The result was what would be expected without the repair of the torn tendon. There was loss of about forty degrees of extension, a large defect above the patella, and considerable limping. It was as a result of this, that the injury to her right knee occurred.

On July 14, 1942, the same patient, now aged fifty-two, while walking on the street came to an uneven spot on the sidewalk where

she caught the heel of her left foot, which was the side with the previously injured knee. To keep from falling, she forcibly extended the right knee, felt a sudden pain and fell to the sidewalk. She was unable to rise and was carried to her home, where I saw her within a half hour of the injury. The diagnosis was very apparent particularly in view of the old injury to the left knee. There was not yet much swelling of the right knee, and a large gap was present above the patella, which was unusually mobile. The back of the patella and the anterior part of the knee joint were easily palpated. Needless to say, loss of extension of the right leg was practically complete. The patient was removed to the hospital and the leg was placed in a posterior splint. The following morning *x*-rays were taken, which revealed no bony injury or abnormalities. She agreed to open repair of the recent injury, but refused repair of the old injury. After waiting a week to allow swelling to subside, and tissue resistance in the knee joint to develop, the patient was operated upon on July 21, 1942.

Under ether anesthesia, the skin was prepared with merthiolate, draped and the knee joint and patella exposed by a horseshoe shaped incision above the patella, with the convexity upward. The quadriceps tendon was found completely torn off from the upper border of the patella with deep tears into the lateral expansions of the tendon. The knee joint was filled with blood clots which were evacuated. The tendon was sutured to the remaining tendon on the anterior surface of the patella with kangaroo tendon. The fascia was sewn with chromic catgut. Four Gm. of sulfathiazole powder were placed in the joint and 4 Gm. in the incision. The skin was closed with plain catgut, the wound dressed, and a circular plaster cast applied.

The postoperative course was smooth, the patient being allowed up in a chair on the eighth postoperative day. On the thirteenth postoperative day, the cast was split and the dressing changed. The wound had healed by first intention. The patient walked about a little with the leg in a cast and used a cane until about five weeks after the operation, when the cast was removed and an elastic bandage applied. She was then able to get about with the use of a cane, and has improved steadily since, until the present time, three months postoperatively. The function in the leg is about normal.

SUMMARY

Total rupture of the quadriceps tendon is a relatively uncommon condition. This patient presents an interesting comparison between an unrepaired rupture of the left quadriceps suffered six years ago, and a repaired rupture of the right quadriceps, sustained three months ago. No attempt has been made to go into the etiological factors of the condition, but it is believed that this case illustrated in one patient the importance of early surgical repair of the torn quadriceps tendon.

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CHRONIC ILEITIS WITH CONCOMITANT URETERITIS*

CASE REPORT

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A CAREFUL search reveals that while over a thousand cases of regional, nonspecific enteritis have been reported from all over the world, no cases of urologic complications have been previously cited. In the decade since the disease was described by Crohn and his co-workers, no definite etiological agent has been found. According to present knowledge from a study of the diseased tissues, the underlying disturbance is an infectious process that gives rise to a nonspecific, granulomatous reaction. The area affected is usually the terminal ileum but other parts of the ileum and jejunum have been described as being similarly involved. As the disease progresses, there is a characteristic formation of fecal fistulas. These are caused by a lytic change induced by inflammatory processes and the fistulas most frequently seen are peri-anal, perirectal, rectovaginal, or burrowing into a previous laparotomy scar. It is of interest to urologists to note that no fistulas have been reported draining into the lumbar area. Another characteristic change is the formation of large, inflamed glands draining the infected area. It is possible that in this case report about to be presented of a concomitant ureteritis with a regional ileitis, the infecting agent spread to the ureter via the lymphatics of the lower ureter which drain into the hypogastric plexus and from there an anastomosis with the inferior mesenteric glands is possible. The infrequency of ureteral complications with ileitis suggests the fact that this lymphatic anastomosis between the intestines and the ureter is either a rarity, or attention has not been sufficiently focused on the urinary tract as a possible source of concomitant disease.

Another point of interest in this disease entity is that the pathologic picture may go on to regression. Probstein and Owenfeld have reported a biopsy in which during the closure of an enterostomy wound three months after an acute onset of nonspecific ileitis, normal tissue was found. In this case, also, the disease changes in the ureter regressed after the intestines were successfully treated.

CASE REPORT

A sixteen-year old male was admitted to the New York Post-Graduate Hospital for the first time on November 26, 1939, with a chief complaint of frequency and nocturia of eighteen months' duration. In addition to having to get up three times at night to void, the patient also had frequently wet the bed. Further questioning elicited a history of intermittent gastrointestinal disturbances over a period of six years consisting of epigastric pain and borborygmus. The past history of this patient was negative except for an abdominal injury in 1935 sustained while playing football.

Physical examination was negative except for a moderate tenderness over the right kidney and bladder region. A medical consultation suggested a diagnosis of appendiceal abscess, adherent to the ureter with resultant infection of the urinary tract.

An intravenous urogram taken shortly after admission (Fig. 1) revealed dilatation of the right renal pelvis and calyces as well as blunting of those of the upper pole. Angulation and constriction at the ureteral pelvic junction, dilatation of the ureter and a diverticular-like

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pouching on the left side of the urinary bladder was also noted.

Cystoscopy and retrograde pyelography (Fig. 2) revealed marked congestion about the right ureteral orifice. There was a definite right pyelectasis with narrowing of the lower end of the ureter, suggestive of stricture due to an extrinsic or intrinsic factor. However, the condition was not deemed sufficient to explain the clinical picture. The possibility of subacute appendicitis was entertained.

Fig. 1. Intravenous urogram showing dilatation of right renal pelvis and calyces with blunting of those of upper pole; also angulation and constriction at ureteral pelvic junction, dilatation of the ureter, and diverticular-like pouching on the left side of urinary bladder.

Fig. 2. Retrograde pyelogram showing right pyelectasis with narrowing of lower end of ureter suggestive of stricture due to extraneous mass.

Laboratory analysis of the urine was essentially negative save for 20 to 30 leucocytes per high power field. The blood count showed 3,350,000 red blood cells, 56 per cent hemoglobin, 6,800 white blood cells with a differential of 59 per cent polymorphonuclear and 1 per cent eosinophiles, and 6 per cent mononuclear, 34 per cent lumphocytes. Blood chemistry was within normal limits. The urine culture showed Bacilli coli acidi lactici and nonhemolytic streptococci. The right kidney urine was negative.

On the fourth hospital day, the patient had a sudden rise in temperature which quickly subsided, only to rise again four days later. On his eleventh hospital day, a barium colon enema was done. An inflammatory infiltrated lesion with typhilitis and mass in the right iliac fossa was suggested. In view of the general colonic atonicity alternating with spasms of the distal colon, the likelihood of concomitant colitis or dysenteric infection was entertained. A chest plate was negative. Surgical consultants believed that the right lower quadrant mass was probably granulomatous. The white cell count at this time was 16,400 with 82 per cent polymorphonuclears, 4 per cent mononuclears and 14 per cent lymphocytes. Urinalysis showed consistent pus. The blood Wassermann test was negative.

The patient was operated upon by Dr. Ralph R. Moolten of the Surgical staff on his eleventh hospital day and he was found to have regional ileitis. The terminal ileum and cecum were involved in an inflammatory reaction. The ileum proximal to the ileitis was anastomosed to the transverse colon. Eight days later all drains and sutures were removed. The patient was discharged on his fifteenth postoperative day.

The boy was readmitted to the hospital on March 21, 1940. In the interim he reported

that he had felt fairly well with drainage from his ileotransverse colostomy. The discharge, however, had increased greatly in the past three weeks, necessitating changing of dressings three times a day. However, he had had normal bowel movements during this time. On examination, the midabdominal scar was found to be well healed with keloid formation, but there was an open sinus at the lower portion. Surrounding the ostium there was a two inch area of induration. Greyish green purulent material oozed out of the opening.

Five days after the second admission, the patient had a resection of the lower ileum and ascending colon performed by Dr. Thomas Russell, the Director of Surgery at the New York Post-Graduate Hospital. The aforementioned sinus was dissected down to its base which was clamped and cut, and the base of the fistula closed. Adhesions between both the large and small intestines and the urinary bladder were separated. Removal of the terminal ileum, cecum, ascending colon, and transverse colon, proximal to the transverse colostomy was done. The portion of the ileum distal to the anastomosis was closed as was the transverse colon proximal to the anastomosis. The patient was discharged from the hospital on his thirty-fifth postoperative day in excellent condition with the wound well healed.

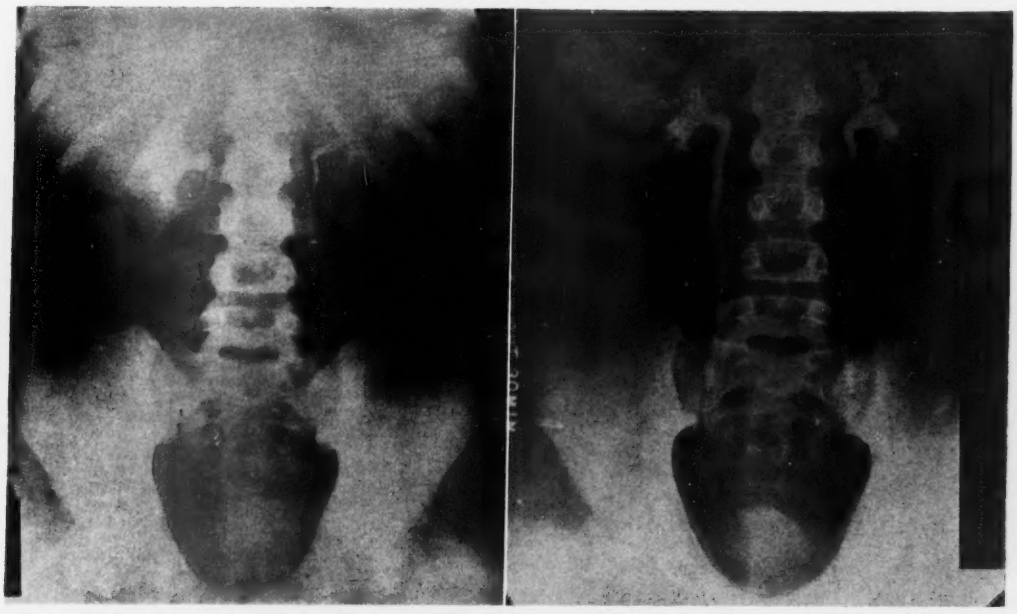

FIG. 3. Four months after temporary ileotransverse colostomy showing persistence of ureteral changes.

FIG. 4. Intravenous urogram six months after permanent resection showing normal right ureter after obstructing mass and inflammatory focus was removed.

An intravenous urogram (Fig. 3) taken on the day of his discharge showed a moderate ureteropelvic dilatation on the right side with angulation at the ureteral pelvic junction as well as in the midabdominal ureter. Partial obstruction (apparently extrinsic) appeared to originate at about the level of the lower sacroiliac margin. There was no evidence of lithiasis. Laboratory findings at this time were essentially as on previous admission.

About six months later, on October 24, 1940, the patient was readmitted to the hospital for the third time for an intravenous urogram. (Fig. 4.) The plates showed considerable improvement, with return of the right ureter and pelvis to normal size. Laboratory findings at this time were normal.

A recent examination in the "follow-up" Urological Clinic in December, 1942, showed this boy to be perfectly healthy and normal in every respect. He had obtained employment as an elevator operator and was performing entirely satisfactory service. He offered no complaints as to either the genitourinary or gastrointestinal tracts and had gained twenty-five pounds in weight and two inches in heigth. The boy has also passed a physical examination and been accepted for duty with the inactive reserve of the Army Air Corps.

CONCLUSION

1. A case is herewith presented of chronic regional, nonspecific ileitis with concomitant ureteritis. The mode of transmission of the infecting agent is unknown, but there is a possibility of lymphatic drainage from the inflammatory mass in the intestines to the ureter.

2. It was also demonstrated that there was definite extrinsic pressure on the ureter from the granular mass of the ileum.

3. As soon as the focus of infection and obstruction in the intestines were removed, the ureter returned to normal physiology and structure.

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The three possible sources of gaseous distension of the obstructed gut are (1) formation of gas as a result of digestive processes, (2) diffusion of blood gases into the intestinal lumen, and (3) passage of swallowed atmospheric air into the intestine. The gases commonly present in intestinal meteorism are nitrogen, oxygen, carbon dioxide, hydrogen, methane, and hydrogen sulfide, the proportions being subject to considerable variation.

MALIGNANT CARCINOID OF THE STOMACH*

CASE REPORT OF A PATIENT TREATED BY SUBTOTAL GASTRECTOMY

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WE are presenting a case report of a malignant carcinoid of the stomach. The diagnosis was established histologically following a subtotal gastric resection. The clinical impression was that of gastric malignancy. Roentgen studies revealed a new growth in the pyloric region of the greater curvature. This finding was corroborated at the operating table. Here the diagnosis of gastric malignancy with regional glandular metastases was made.

A brief historical review of this subject attributes the first description of carcinoid tumors to Langhans in 1867. It was in 1888 that the true differentiation between carcinoid and ordinary adenocarcinoma was made by Lubarsch. The term, carcinoid, was used for the first time by Oberndorfer in 1907. The cytoplasm in the cells of carcinoid was shown by Gossel and Masson to have a selective affinity for silver salts. These cells were identified as argentaffin cells. Thereafter the tumor was called argentaffinoma (1914). Raiford reported the first clinical case of a malignant carcinoid tumor of the stomach (1933). Pettinari of Italy is credited with removal of a gastric carcinoid from a patient with complete pyloric obstruction (1935). Two years later Entwisel successfully removed multiple carcinoid tumors from the stomach of a young woman. Until 1939, a review of the literature by Plaut revealed only nine carcinoid tumors of the stomach. Lemmer, of Wisconsin, surveyed thirty-one cases of carcinoid. Of this number only one was located in the stomach. This was a benign lesion. We are presenting what we believe to be the eleventh carcinoid tumor of the stomach and one of the few to display evidence of malignancy.

PATHOLOGICAL PICTURE OF CARCINOID

This type of tumor confines its location to the gastrointestinal tract. The appendix is a common site, the small and large intestine are the next most frequent locations. Infrequently they are found in the rectum. Rarely is the stomach involved. Originally, carcinoids were accepted as benign tumors. This belief is no longer tenable. Many cases have been reported in which carcinoid tumors displayed malignancy and metastasized to lymph glands and the liver. At present according to some reports 17.5 to 20 per cent of carcinoids are malignant.[2,4]

Ewing states: "carcinoids are generally found at autopsy, when they appear as small, firm, yellowish, circumscribed nodules from 0.5 cm. to 1 cm. in diameter. These tumors are situated in the submucosa and muscularis covered with smooth mucosa and thickened peritoneum. Larger tumors may protrude into the intestine or peritoneum, or encircle and constrict the lumen, or infiltrate the surrounding tissues. Occasionally they are multiple."

The microscopic pathology of carcinoid has been studied by many investigators. Masson published a series of papers, from 1914 to 1930, in which he interpreted these tumors are arising from an endocrine gland connected with the sympathetic nervous system. Cells were found which contained many argentophile granules (argentaffin cells or cells of Kultschitzsky). Masson

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noted the association of the tumors with tumor-like proliferation of the terminal nerve-fibrils, producing a form of obliterat-

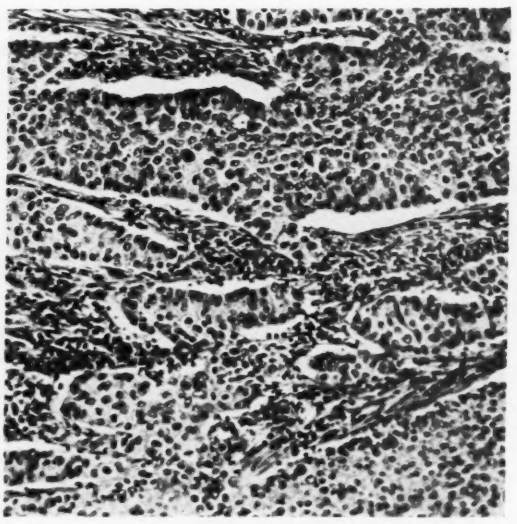

Fig. 1. Ovoid and polygonal shaped cells arranged in cords and alveolar-like masses. Hyperchromatic nuclei and mitotic figures are visible. (150 ×)

ing appendicitis. He described an apparent interchange of argentaffin cells between the epithelial fibrils and the nerve-filaments. He conceived this structure to signify a functional union between the glands and the sympathetic nervous system.[2] It is generally agreed that this type of tumor arises from the chrome cells near the basement membrane of the crypts of Lieberkuhn in the gastrointestinal tract.[4]

A carcinoid may present histological features suggesting a low grade melanoma or a basal cell carcinoma. Structurally they present groups of epithelioid cells, cuboidal or cylindrical, granular and argentophile, arranged in small groups indistinctly acinar, or in broader cords, or at times in palisade form.[2]

CASE REPORT

The patient was a white female, sixty-eight years of age, who was admitted to Kings County Hospital of Brooklyn, New York, on August 5, 1942, and discharged from the surgical service on September 13, 1942.

Her chief complaints on admission were weakness, and fatigue for the preceding three months, with a loss of seventeen pounds in weight over a period of seven months. Since May, 1942, she was observed and treated by a family physician for anemia. She was finally

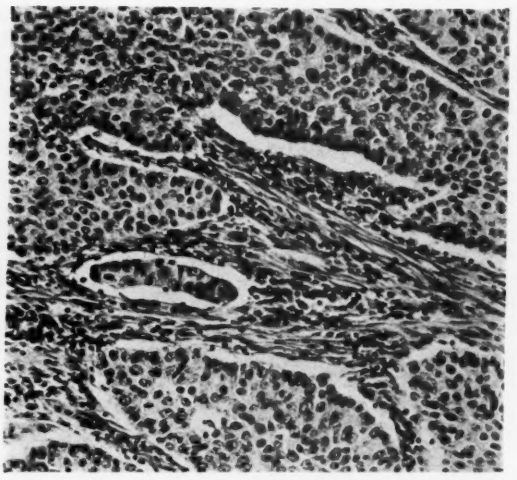

Fig. 2. Invasion of the muscularis by carcinoid cells. Central tumor embolus seen in a vascular channel. (150 ×)

sent to the hospital because of a marked anemia due to "possible internal bleeding." The past history elicited no factors pertinent to her present illness.

Physical examination revealed a well developed, obese, white female, clinically anemic, not in acute distress. The salient physical findings were: Blood pressure 155/95; pulse 92; respirations 24; temperature 100°F. Heart sounds were of good quality with slight increase in the first sound at the apex. No masses were palpable in the abdomen.

Laboratory data revealed the following: Red blood cells 2,900,000, hemoglobin 7 Gm., (hypochromia and microcytosis present) white blood cells 8,750; 84 per cent polymorphonuclears, 16 per cent lymphocytes; the urinalysis showed specific gravity 1.017; albumin one plus, microscopic negative; blood chemistry: urea 38, creatinine 1.24, sugar 87 mg. per cent.

Gastric analysis on August 12, showed no free hydrochloric acid in any specimen, no lactic acid, no blood and no bile. The total acid values in five specimens were respectively 7, 14, insufficient, 13, 10. The second analysis on September 2, showed one plus blood in all specimens. The total acidity was reported in five specimens as 5, 16, 5, 19, 10.

The electrocardiogram demonstrated left axis deviation. Roentgenograms revealed a constant irregular cauliflower-like, plum-sized

defect in the contour of the stomach. This was located in the pyloric region of the greater curvature. The picture was compatible with a new growth.

Barium meal showed a six-hour partial retention of stomach contents and confirmation of the above mentioned constant irregularity. The head of the barium meal was in the transverse colon, the tail was seen in the terminal ileum.

On August 25th surgery was undertaken. A subtotal gastrectomy was performed for prepyloric malignancy (posterior Pólya type gastrojejunostomy). At the operation the suprapyloric lymph glands were enlarged, firm, and suggested metastases from the stomach. No nodules could be found in the liver.

Postoperatively the patient was given a prescribed standard routine and was discharged on September 13th. Radiation therapy was suggested postoperatively but not given. The temperature was elevated for six days postoperatively, rising to 102.8°F. on one occasion. From the eighth postoperative day to the date of discharge the temperature was normal.

Pathologically, the specimen consisted of a portion of stomach with a neoplasm noted in the pyloric region. The neoplasm was projecting into the lumen and arose from the mucosa. The mass was cauliflower-like in appearance and measured 4 by 6 cm., it was pedunculated in character, firm and grayish white in color. The surface was mottled. The distal part of this mass was crater-like in contour; the borders of the crater were hardened. This new growth was easily demarcated from the apparently normal surrounding mucosa.

Microscopic examination revealed the section to be one of the stomach in which there was noted a neoplasm composed of ovoid and polygonal shaped cells arranged in diffuse and alveolar-like masses and in cords. Running between the cells was a stroma composed of rather dense fibroblastic tissue dividing the cells into alveolar-like masses. Some of the cells showed hyperchromatic nuclei but all the cells did not appear to be malignant in character. These cells were present in the muscularis and suggested invasion of this layer.

Diagnosis: Carcinoid of the stomach (malignant). (Figs. 1 and 2.)*

CONCLUSION

A case is presented which after clinical and laboratory studies substantiated the preoperative diagnosis of an obstructing gastric malignancy. At the operating table the impression was confirmed showing, in addition, metastases to the regional lymph glands but not to the liver. A subtotal gastrectomy was performed. Histological studies revealed the lesion to be a malignant carcinoid.

The patient was discharged nineteen days following operation. At this writing, more than one month later, the patient is living and well, has maintained her weight and has no difficulty in retaining a regular soft diet.

We wish to express our appreciation to Dr. William W. Hala, Director of our Pathological Laboratories, for corroborating the histopathological findings.

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* In view of the fact that the gross specimen was believed to be a true carcinoma, no silver stains were made. Later when the diagnosis of carcinoid was entertained silver stains were attempted but the resulting slides did not permit photomicrographs of merit. We regret, therefore, the absence of an illustration demonstrating argentaffin cells.

SECONDARY OR DELAYED HEMORRHAGE FROM A RUPTURED SPLEEN

CASE REPORT

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THIS case adds one more to the accumulating records of delayed hemorrhage from a ruptured spleen.

CASE REPORT

R. H. (Nazareth Hospital 2822), a white male of twenty-nine was first seen on July 9, 1941 in his home. He was lying on his side in bed with his knees drawn up and seemed reasonably comfortable in this position and was smoking a cigarette. He recited his history readily and answered questions promptly. His color was fine and he was in no wise shocked. His greatest discomfort was in changing position during which process he had a great deal of upper abdominal pain. The story he gave was this: After having had breakfast at a restaurant on his way to work the night before he had broken out in a cold sweat as he walked down the street and shortly thereafter was seized by abdominal pain which was generalized and which doubled him up. A little later he felt the pain in both shoulders. He hailed a fellow bakery-wagon driver who took him in his wagon to the stable where friends gave him a liquid to drink which he promptly vomited. He went out on the route, having a helper do the driving but stopped at a hospital receiving-ward where he was examined, given some pills and told to return the next day. He noticed a striking thing by this time, namely, his abdomen was getting larger and that his "pants felt tight." Opening the top buttons he felt better but later when he tried to close them he could not do so. His abdominal and shoulder pain persisting, the man decided to go home and got a taxi. On the journey to his house he knelt in the back of the cab clutching his abdomen to relieve the intense pain as much as he could. At home he got right into bed and in the morning called his doctor. The doctor on examining him noted a marked rigidity of the muscles of the abdominal wall and believed that he was dealing with a ruptured peptic ulcer and called me to see the patient. I found him as I have already recited and was likewise struck by the board-like rigidity of the abdominal wall. Believing, too, that we were dealing with a ruptured peptic ulcer and being concerned over the number of hours which had elapsed since the onset, I arranged immediately to send the patient to the hospital, and as soon as possible after arrival to the operating room. The general condition being very good (temperature 99°F., pulse 118, respirations 26, red blood cells 4,430,000, hemoglobin 71 per cent, white blood cells 11,900, polymorphonuclears 76 per cent, lymphocytes 13 per cent, rods 11 per cent), no preliminary measures were considered necessary but a set-up for giving intravenous glucose during the operation was provided.

With the patient under spinal anaesthesia a high right rectus incision was made. Through the peritoneum black liquid could be seen which on the opening was obviously blood—fresh and clotted mixed. The quantity was large. The liver was explored and found unbroken. The omentum, which directs as well as protects, was found turned upward and leading to the spleen. A rent could be felt in the surface of this organ. The peritoneum was then closed and another opening made in the left hypochondrium paralleling the rib margin. Fortunately, with fingers grasping the pedicle, the spleen could be elevated and freed rapidly because bleeding was now marked, coming from the surface of the spleen along the edges of a deep rent, and also from the depth of this clot-filled rent near the pedicle itself. The pedicle was clamped and the spleen severed. A heavy silk tie was used for the pedicle. Residual bleeding in splenic vessels and from the pancreatic surface was controlled by finer silk suture-ligatures. Through all this the patient's general condition remained excellent; there was no apparent shock. Nitrous oxide-

ether anesthesia had had to be resorted to shortly after the first incision was made, no true relaxation having been secured from the spinal (150 mg. procaine crystals). Intravenous glucose 5 per cent in normal saline was being given from the start of the operation. After the splenectomy all blood and blood clots were allowed to remain in the peritoneal cavity. Both wounds were now closed (just the peritoneum itself having been previously closed on the right). No drains were inserted.

The patient's recovery was marred by a bronchopneumonia combatted successfully with sulfathiazole, by a secondary anemia (lowest red blood count 3,770,000, hemoglobin 67 per cent) for which repeated transfusions were given and by a superficial collection of serum and serosanguineous material in the left sided wound. The patient left the hospital on his twenty-fourth day and recovery was complete; the wound healed completely, and the patient was walking, etc., three weeks after that.

REMARKS

Upon going into further details in the history, particularly as to the question of preceding trauma, the following story was obtained: On June 25, 1941, about two weeks before the onset of his present trouble, the patient had been watching a sand-lot baseball game from the players' bench along the first base line and had been struck in the lower left chest (indicating a point over the spleen) by a line drive foul ball. He felt as if the wind had been knocked out of him but after the players had rubbed his side he felt all right and walked four blocks to his home "stopping for a beer on the way." Later in the afternoon he took his children for a walk, returned home, ate a good dinner and retired at 7 P.M. About 10 P.M. he awoke with a feeling that he could not get his breath but when he got up and walked around a while this left. At work later that night he had shoulder pains on lifting heavy baskets but attributed the pains to draughts. From then on he worked every night although his shoulder pain was present daily at some time or other. For four days before his severe pain he had had epigastric pains suggesting to him that "something was stuck there." Then came his trouble as already related.

It presented one sign other than the classical ones which may have some significance—the noticeable rapid distention of the abdomen—to the point at which the patient could not re-button his trousers.

As with many other such cases it was mistaken for a ruptured peptic ulcer. If a more careful history had been elicited this might not have been the case, although the ulcer diagnosis could not have been eliminated entirely.

The absence of shock and signs of hemorrhage preoperatively is noteworthy. One would have expected these. Perhaps the second hemorrhage had arrested itself, although the blood loss had not been small, and the active bleeding seen when the spleen was exposed may have been due to the reopening of vessels by operative manipulation itself. Silk was chosen especially because of the exposed pancreas in fear of early digestion of catgut.

The leaving in of the blood and the omission of drainage worked out very well here, the abdomen was soft in forty-eight hours and remained so except where the serous collection occurred.

BONE MARROW AND FAT EMBOLISM FOLLOWING FRACTURE OF THE FEMUR*

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MANY reports of fat embolism following fracture of the long bones of the lower extremity are in the literature. Occasional reference in textbooks and in the literature is made to the general subject of tissue embolism but we were able to find only one report[1] on the occurrence of bone marrow embolism.

FIG. 1. Microphotograph showing piece of bone marrow in branch of pulmonary artery; hematoxylin and eosin; × 108.

We have recently observed a case of bone marrow embolism accompanied by fat embolism following the operative reduction of a fracture of the neck of the femur.

CASE REPORT

The patient was an eighty-six year old female who was admitted to the hospital on June 8, 1942 because of pain in the left hip and inability to walk following a fall on the previous day. The roentgenogram showed a fracture of the neck of the left femur. An open reduction, which included the insertion of two three-inch wooden screws, was performed on June 8th. The patient ran a low grade fever until the day of her death on June 12th.

The external postmortem examination of the body revealed a recent skin incision over the lateral aspect of the left great trochanter. The left lower extremity appeared to be in fairly good alignment. The wooden bone screws were firmly embedded into the fragments and only slight mobility at the point of fracture could be elicited. The only other gross finding of any consequence was a moderately dilated 425 Gm. heart.

Microscopically, an early bronchopneumonia and a 2 mm. leiomyoma of the capsule of one kidney were the pertinent findings of general interest. Four sections of lung tissue were studied. Each of these showed numerous droplets of fat in the capillaries when stained with Sudan IV. In each of two 1 to 2 mm. branches of the pulmonary artery, a mass of bone marrow was present. Besides the myelocytic and erythrocytic elements, these contained megakaryocytes as well as macrophages with phagocytosed hemosiderin pigment. The larger piece contained nine fat cells. (Fig. 1.) Some of the glomerular capillaries and the arterioles in the kidneys also contained droplets of fat when stained with Sudan IV. No fat was found in the vessels in the heart and liver.

COMMENTS

The immediate cause of death was probably a combination of factors which included the advanced age, shock, operative procedure, bronchopneumonia and fat embolism. The bone marrow embolism

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played little or no part in the cause of death.

We were unable to determine whether the bone marrow embolism occurred as a result of the fracture itself or as the complication of the operative procedure. The mechanism of entry was probably by way of the lacerated veins in the bone, the mouths of which remain open prior to occlusion by thrombosis. This is the commonly accepted mechanism for fat embolism as a result of trauma to bone. The fragments of marrow could have entered the vein either spontaneously or were forced into it mechanically by the bone screws.

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Appendical, bowel, biliary, and renal obstructions give rise to an intermittent crampy pain. The acme of the colic is of variable duration, lasting usually for several seconds to a few minutes. In lesions that assume the character of an inflammation with the elapse of time, there is usually as well a constant distress between the colics. The distresses occasioned by the various acute abdominal ills do not lend themselves well to comparison.

VON RECKLINGHAUSEN'S NEUROFIBROMATOSIS

A CASE OF HEPATOMEGALY AND SPLENOMEGALY

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VON Recklinghausen's neurofibromatosis is a complex syndrome, capable of protean manifestations, and is more common than has been supposed. Of approximately 500 men and women ranging from seventeen to fifty-five examined for employment in a department store and an industrial firm during a period of one month, the author noted that eight of them, three male and five female, or about 1.6 per cent presented stigmas, as skin pigmentations, café-au-lait spots, and multiple cutaneous neurofibromas. Basing our total population upon this figure, there are approximately 1.75 or 2,000,000 individuals with this condition.

Sharpe and Young[1] quote a great number of isolated cases presented in the literature. Yet the incidence of the syndrome must be greater than recorded as many, presenting evidences of neurofibromatosis come to the physician because of something else and are, therefore, classified under other headings. Gardner and Frazier[2] (1930), in a review of the literature, were able to collect forty-four cases of bilateral tumors of the acoustic nerve, thirty-seven of which were associated with neurofibromatosis. Van Bogaert[3] (1934), and De Klejn-Gray[4] (1932) reported additional such cases. Davis[5] has shown that about 10 per cent of the cases of tumors of the optic nerve reported in the literature (five in his own series), were associated with neurofibromatosis of the peripheral nerves. Lesions within the brain, gliosis, gliomas, and meningiomas, have also been reported.[5] The upper eyelid and region about the orbit and temple are common sites of these growths.[5] Defects in bony structure, scoliosis, irregularity in the shafts, and differences in the length of the long bones have been described.[6,7] Soft nodules in the skin, known as molluscum fibrosum and café-au-lait patches, may accompany the more obvious tumors of the nerves, or they may be the only visible evidence of the disease. The endocrine and autonomic associations with neurofibromatosis have been stressed by Levin and Behrman.[8] Involvement of the pituitary,[9] thyroid and pancreas[10] have been noted. A high incidence of feeblemindedness has been recorded in those showing marked involvement.[11] Heublein et al.[12] reviewed the roentgenographic findings of the condition.

Etiology. The cause of the disease remains unknown. It is of hereditary nature, and follows the Mendelian law as a dominant trait.[11] Sharpe and Young[1] suggest that from a congenital or inherited mesodermal abnormality, an embryonic tissue arrest is formed, which at birth, childhood, puberty and pregnancy may be clinically manifest, depending upon its response to the stimulation of the normal physiologic growth factor. Neurofibromatosis appears in both sexes, and makes itself apparent, as a rule, at the time of puberty; however, in many instances, the manifestations appear, or first become evident in middle life. It is further characterized by the numerous complications which may develop during its evolution and the progressive character of its course.

Pathology. It is beyond the scope of this paper to enter into a detailed discussion of the origin of the tumor. This point has occasioned debate for many years. A satisfactory classification of these tumors is

difficult, owing to the complex structure of the nerve trunks and the uncertainty of the source of the supportive cells which accompany nerve fibers.[13] Penfield[14] and others support the mesodermal origin of the tumors from the connective tissue sheath of nerves (perineurium). Masson,[15] on the other hand, believes that the tumors arise from the cells of the sheath of Schwann, and are therefore ectodermal in origin.

Best known are the skin lesions, the characteristic soft or elastic nodules, known as molluscum fibrosum, and pigmented patches in the skin, smooth nonelevated light coffee colored. The presence of these alone, without other manifestations, are most often encountered. Some authors consider the presence of these two alone or as incomplete forms or formes fruste of the disease.

The tumors may be of various sizes. They most often affect the peripheral nerves and are scattered over various parts of the body. Lesions within the brain, gliosis, etc., may be present. In general, neurofibromas are benign encapsulated tumors. Sarcomatous degeneration occurs in from 12 to 13 per cent of patients showing stigmas of Von Recklinghausen's disease.[16] Except in the lungs these sarcomas extend by local invasion rather than metastasis.

Cranial nerve palsies and clinical signs of pressure of the tumors are not uncommon. They depend upon the location and size of the tumors. Cortical involvement, with resulting defective memory, idiocy, and association with tuberous sclerosis have been noted.

Multiple neurofibromatosis is a disease of many organs, and endocrine dyscrasias, such as myxedema, diabetes mellitus, acromegaly and involvement of the adrenal glands may be part of the clinical syndrome.

Defects in hearing, due to bilateral acoustic neurofibroma and defects in sight due to tumors of the optic nerve may be associated symptoms.

A great variety of bone abnormalities due to the involvement or erosion of the bone may be encountered. Hyperplasia of bone shafts occur including changes which in the *x*-ray film appear as bone cysts. Moore[7] believes that the bony changes are not merely associated with but are the result of the changes in the nerve, either directly or indirectly.

The syndrome may sometimes be an accidental discovery in the course of a routine *x*-ray examination. Such is the case of an intrathoracic neurofibroma reported by Lavender and Prentice.[17]

Pressure upon important structures, hemorrhages into a pachydermatocele, infections in the large tumors and malignancy may complicate and obscure the picture.

CASE REPORT

The patient, a forty-eight year old married woman, white, was first seen by the author at the Out-Patient Clinic in May 31, 1941, having been referred by the Chest Follow-Up Clinic for an opinion on her thyroid enlargement. Her personal history revealed several admissions to the Mt. Sinai Hospital because of hemoptysis. The first in 1932, revealed the cause by bronchoscopy, as a globular mass, semipedunculated and easily bleeding, covered by normal mucosa located in the right lower bronchus. Biopsy showed adenoma with angiomatous stroma. She had several one-day admissions for bronchoscopy thereafter. Physical examination during 1932 to 1940 revealed no other abnormality. Her present complaints were choking sensation in the throat of six months' duration with increasing irritability and nervousness.

No pathological disorder was noted except for a slight nodule on the right lobe of the thyroid gland, and the clinical impression after the first examination was a nontoxic thyroid adenoma. The patient was seen again several months later, and no change in her thyroid status was noted. She, however, complained of increased menstrual bleeding with clots and was therefore referred to the gynecological clinic. She was later admitted to the hospital in January, 1942, for her gynecological complaints. The records at this admission showed a painless hepatomegaly and splenomegaly of unknown origin, with a uterine fibroma, but no skin lesions. A dilatation and curettage were done. Roentgenologic examinations of the

chest were repeated and showed the same paramediastinal mass noted in 1932. She was again seen by the author in April, 1942. At this time she presented disseminated soft nodules in the skin with multiple café-au-lait patches, and in addition a spleen, palpable two fingers breadth below the costal margin, and a liver three fingers breadth below the costal margin. Upon questioning she stated that the skin lesions were of recent occurrence. These findings pointed to a multiple neurofibromatosis syndrome.

Comments. The case of neurofibromatosis presented, suggests a picture of a syndrome rather than the solitary manifestation of a disease. This patient has been studied and treated for several specific complaints intermittently over a period of ten years by various members of the hospital staff. There was no suspicion of neurofibromatosis until attention was focused on the disease by the appearance of multiple fibroma mollusci on the skin. The question may be raised whether her multiple complaints, the thyroid enlargement, benign tumor of the bronchus and uterine fibroids, may not be associated with neurofibromatosis. Most perplexing and unusual of all was the sudden appearance of a painless, hepatomegaly and splenomegaly. Is it coincidental that her enlarged spleen and liver occurred at approximately the same time that the skin lesions appeared? Or is it possible that this case is actually the evolution of the course of a progressive disease? Literature on the disease seems to indicate that no organ is immune to involvement.

Because it is rarely indexed, neurofibromatosis appears in statistics as a rarely encountered disease. The Mt. Sinai Hospital with an approximate total admission of 15,000 to 17,000 annually have three patients classified as having Von Recklinghausen's disease, as far back as the records go. On the other hand the author, in the course of 500 employment examinations over a period of one month found eight cases of the disease.

This discrepancy may be accounted for by the fact that neurofibromatosis in many instances may have been noted, but the emphasis was placed on the accompanying complaint, without any connection being suggested between the two. It is, therefore, the author's opinion that existing statistics do not reveal the true incidence of neurofibromatosis.

SUMMARY

1. Multiple neurofibromatosis is a constitutional disease with protean manifestations.

2. It is much more common than is supposed. The author's figure based on a survey of 500 people during a month's period, reveal it present among 1.6 per cent of the population.

3. Its chief features and most common signs are the soft, elastic, pinkish nodules along the course of peripheral nerves, known as molluscum fibrosum and pigmented café-au-lait colored patches. Other features are bony abnormalities especially scoliosis, endocrine dyscrasias, mental changes and defects in hearing and sight.

4. The disease is hereditary and is present in both sexes. It appears as a rule at puberty or in middle life.

5. A case is reported associated with a hepatomegaly and splenomegaly along with the common skin manifestations.

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DISTENSION, nausea and vomiting with feculent regurgitation accompanied by *intestinal colic* indicates the presence of obstruction of the small intestine. Distension, frequently of high grade, unattended by nausea or vomiting, with no return of colored intestinal fluid on gastric aspiration, but, accompanied by *intestinal colic*, is synonymous with obstruction of the colon.

SOLITARY NEUROGENIC SARCOMA OF THE MESENTERY*

REVIEW OF THE LITERATURE AND REPORT OF A CASE

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NEUROGENIC sarcomas arise from the nerve sheaths of either somatic or sympathetic nerves and so may occur anywhere in the body. Only infrequently do they occur in the abdominal cavity and but rarely in the mesentery. There are only four cases of neurogenic sarcoma of the mesentery reported in the literature since 1909. Not all of these stand up under close scrutiny, and none of these was a solitary tumor at the time of surgery. In 1909, Harbitz[1] reported a case of generalized neurofibromatosis in which the patient died of carcinoma of the ovary with peritoneal metastases. At postmortem examination a large nodular tumor mass was found in the mesentery which microscopically was not carcinoma, but consisted rather of spindle cells and probably was a sarcoma. Whether it was a true neurogenic sarcoma remains a subject of controversy. In a critical review of the literature in 1931 Stewart and Copeland[2] do not include any neurogenic sarcomas of the mesentery.

In 1936, Sailor[3] reported a case of multiple neurogenic sarcomas in the mesentery, liver and omentum. Subsequently, Warren and Commer,[4] in a review of 163 cases of fibrosarcoma, reported one neurosarcoma of the mesentery without any details as to its location, whether or not it was solitary, or its pathologic picture. They only state that the patient died. Then Ransom and Kay[5] reported a case of neurogenic sarcoma in the mesentery of the terminal ileum, and when the patient expired seventeen days after surgery, metastases were found in the liver and on the subdiaphragmatic peritoneum.

The case to be presented is unusual in that at the time of surgery a large solitary neurogenic sarcoma was found in the mesentery of the jejunum without metastases and that the patient died of metastatic involvement one year and nine months after its removal.

CASE REPORT

G. R., a sixty-two year old white male, entered Michael Reese Hospital on July 23, 1939, complaining of chills, fever, and right lower quadrant pain during the twelve days prior to admission. He stated that he had been in good health until twelve days previously when he was suddenly seized with a shaking chill lasting thirty minutes. His temperature rose to 103°F. orally, and he developed a constant aching pain in the right lower quadrant which was aggravated by sudden deep breathing or movements. The pain persisted, and the patient continued to have chills and fever until the time of admission. The patient had regular bowel movements until this episode, but since then was constipated and required enemas.

Physical examination revealed the following: temperature 100°F. rectally, pulse 90, respirations 26, blood pressure 130/80. The patient was a well developed, obese sixty-two year old white male lying quietly in bed and perspiring somewhat. He appeared to be rather drowsy but readily awakened to answer questions very co-operatively. There was no dyspnea, cyanosis, jaundice or pallor.

There were no tumors or discolorations of the body surface. The head, neck, and chest were normal. The abdomen was very obese. The liver, spleen, and kidneys could not be palpated. There was a mass present in the right lower quadrant with marked local tenderness here. There was no rebound tenderness and no fluid present in the abdomen.

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Red blood cells were 4.6; hemoglobin 70 per cent, white blood cells 27,250, neut. polymorphonuclears 85, basophiles 1, lymphocytes 11, monocytes 2, urine negative. The stool showed some occult blood in three out of four samples.

Fig. 1. Film showing cyst and entire colon filled with barium.

The patient ran a septic temperature, between 103° and 99°R for fourteen days. The only therapy was bed rest.

On July 24, 1939, the blood sugar was 100, nonprotein nitrogen 36, icteric index 5, Wassermann and Kahn tests were negative.

On August 9, 1939, the chest fluoroscopy was negative.

With barium enema the opaque clysma passed easily retrograde to the cecum and on the right apparently encircled a dense shadow which measured at least 8 to 9 cm. in diameter. This tended to displace the transverse portion of the colon slightly upward. The cecum and ascending colon were apparently not attached to the mass. There were several very small diverticula in the sigmoid. The mass seemed to lie along the right iliopsoas margin below the transverse colon and had a large (5 to 6 cm. diameter) cavity which was apparently filled with air or gas. The mass was distinctly away from the outline of the cecum and ascending colon, so that it appeared unlikely that the lesion had for its origin a perforation of the cecum or appendix. (Fig. 1.)

The patient's fever finally subsided, and so he was discharged on August 15, 1939. He was readmitted on October 15, 1939, for a series of gastrointestinal *x*-rays. He had been losing weight and had been running a septic temperature since his discharge.

Fig. 2. Film showing proximal and distal communications of cyst with small intestine. The proximal and transverse portions of the colon also are outlined by barium.

X-rays taken on October 18, 1939, revealed a large irregular area of barium accumulated in the right lumbar region and having the appearance of a large encapsulated cavity associated with the small intestine through perforation.

Impression: The possibility of perforation of the small intestine with abscess formation and encapsulation, or breakdown of a mesenteric cyst with rupture into the small intestine must be considered. (Fig. 2.)

The patient was again readmitted on November 15, 1939, because he had lost thirty-five pounds in weight since July and still continued to run a septic temperature up to 103°F. daily.

Physical examination revealed the temperature 101.4°F., pulse 88, respiration 20. The mass was still present in the abdomen extending about 4 cm. above, below, and to the right of the umbilicus.

On November 9, 1939, an exploratory laporotomy was performed by Dr. Morris L. Parker. A large mass about the size of a fetal head was found to which the small bowel and

colon were adherent. Liver, spleen and other organs were negative. The mass was dissected free and was found to be grey in color and

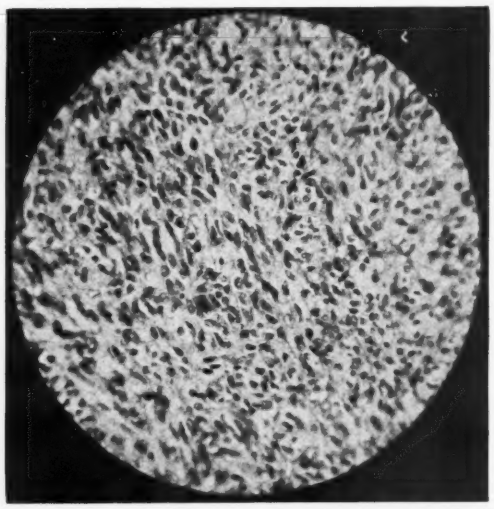

Fig. 3. Microphotograph showing typical spindle-shaped cells.

having an abscess cavity containing about 500 cc. of fecal—smelling, dirty, brownish pus in which fruit seeds were noted. The thick wall was of mushy consistency and from it extended many grape-like masses of tissue of similar consistency. The jejunum was intimately adherent to this mass and communicated with it through two fistulas. The proximal opening in the jejunum was twelve inches distal to the ligament of Treitz and the other opening was twelve inches distal to this. The jejunum was separated from the mass, and it was found to be negative except for inflammatory tissue. This inflammatory tissue was removed from the openings, and they were closed with intestinal catgut. The origin of the tumor was in the root of the mesentery close to the third and fourth portions of the duodenum. No enlarged lymph nodes were noted. The mass then was peeled off the posterior leaf of the mesentery of the transverse colon and removed. The abdomen then was closed. The patient received 500 cc. of citrated blood and 1,000 cc. of 5 per cent glucose in saline during the operation and left the operating room in good condition.

The postoperative course was complicated by a fecal fistula which was kept clean by continuous suction and was closing at the time of discharge.

The pathologic report showed the specimen to consist of a piece of tissue measuring 24 by 14 cm. One surface presented multiple nodular formations peering through the wall, measuring 3 cm. Elsewhere this surface presented multiple tags of fat with many hemorrhagically discolored areas. The wall was 3 cm. thick. The other surface throughout its extent consisted of a mass of ridges and nodules and was semifirm.

Microscopically, in the sections, predominantly spindle shaped cells were arranged in masses separated by thin strands of outspoken fibrous connective tissue. The fields varied in cellularity, the spindle shaped cells were either closely approximated or separated by a loose or vacuolated tissue. They varied markedly in size, had long neutrophilic interweaving cytoplasmic processes, and elliptical, often somewhat blunt-poled nuclei. The chromatin formed a fairly thick network. Nucleoli were often seen. Mitotic figures were fairly frequent in some areas. The cells were arranged in sheets, whorls and strands. Extravasated red blood cells and thrombosed vessels were noted beneath the inflammatory border.

Diagnosis: microscopic—neurogenic sarcoma. (Fig. 3.)

Postoperatively the patient was in good health and gaining weight for nine months, during which time he left the city. He then began to lose weight, developed multiple fistulas in the area and multiple tumors could finally be palpated within the abdominal cavity and liver. He expired one year and nine months after surgery and no autopsy could be obtained.

REMARKS

The pathologic picture of neurogenic sarcoma has been well classified by Stewart and Copeland.[2] Much argument still exists as to whether they are of neuro-ectodermal or mesodermal origin. Excellent reviews of the evidence are presented by the above authors and by Ransom and Kay.[5]

Neurogenic sarcomas are notorious for tending to remain locally malignant and recurring after inadequate surgical removal, but failing to give rise to distant metastases. Stout[6] found that 74 per cent of peripheral nerve neurogenic tumors recurred following excision, but in only 20 per cent did they show evidence of metastases. This apparently is not true for those within the mesentery, for of the four previously reported cases, only three can be

analyzed, and all of these had metastases in various locations including the liver. In our own case thorough exploration at the time of surgery failed to reveal any metastases, although the patient died with multiple metastases one year and nine months later.

In removing tumors of this type it is well known that wide excision is necessary. If the involved nerve is found along with the tumor, it should be resected as far as possible, since numerous recurrences have been noted after removal, frequently in the distal nerve segment.

CONCLUSIONS

1. Solitary neurogenic sarcoma of the mesentery is rare, this being the only reported case of this type.

2. In this case the patient presented none of the other stigmas of von Recklinghausen's disease.

3. Diagnosis of a cystic tumor communicating with the small intestine was made roentgenographically preoperatively and proved by surgery.

4. Successful surgical removal was carried out, the patient dying of metastases one year and nine months later.

5. Neurogenic sarcomas of the mesentery apparently differ from those occurring along peripheral nerves in that in all reported cases these possess a far greater tendency to give rise to metastases.

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LYMPHOSARCOMA OF THE STOMACH WITH PERFORATION*

GASTRIC RESECTION WITH RECOVERY

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TAYLOR collected through 1937, 152 cases of primary lymphosarcoma of the stomach from the literature. They constitute about 1.5 per cent of gastric neoplasms. The average age in his series was 44.3 years. The preponderance of males to females is approximately 3 to 2. Trauma of habits is believed to be an exciting cause. Pathologically, Warren and Lubenski have designated as primary lymphosarcoma; malignant lymphoma, Hodgkin's disease, lymphosarcoma and reticulem cell sarcoma. The primary differentiation is whether the tumor arises from lymphocytes or reticulem cells in the lymph follicles found in the submucosa. The growth infiltrates all layers. It causes a thickening of the submucosa causing the giant rugae seen in the roentgenograph. It tends to be a bulky growth with shallow broad ulceration which deepens rapidly with necrosis due to infiltration of the submucosa. It is usually found along the curvatures in the prepyloric area. Pyloris stenosis is rare. Perigastric and adjacent retroperitoneal nodes are most frequently involved by extension.

Clinically, pain of ulcer type is most commonly found. Dyspepsia and anorexia are common; vomiting is not obstructive; weight loss is moderate; perforation is more frequent than in carcinoma and a mass is commonly present. Free hydrochloric acid is usually present and there is no definite roentgenological picture, although giant rugae are marked. Gastroscopy is not conclusive.

Radical subtotal gastrectomy followed by intensive deep radiation therapy is the treatment of choice. Pack and McNeer recommend a total dosage of 2,500 to 4,000 r. Radiation therapy gives remarkable results alone and radiation may well be used repeatedly.

Taylor reports an approximately 10 per cent cure in consideration of all cases. Recent series report 40 to 50 per cent cures. Koucky Beck and Atlas distinguish three types of cases: (1) the acute perforation with peritonitis; (2) the perforation which walls itself off with transient peritonitis, and (3) the perforation into another structure without communication into the abdominal cavity. There are two cases each of the first two types. It is my opinion this case would have fit into the first type if the perforation had been of longer duration.

CASE REPORT

A forty-nine year old male presented himself at my office on January 20, 1941, with the following story: He had always been in good health, having had no previous illnesses in his life. One year previous to his visit, he had had gradual onset of cramp-like pains in the epigastric region. These pains would radiate through to his back, and when the cramp character had subsided, would leave a background of dull, upper-abdominal pain. The intensity of the pain had gradually increased, and with it had appeared gaseous eructations, flatulence and nausea. This was intensified by all types of food, and one day previous to this date water also aggravated the condition. There had been no vomiting. Stools were normal and there had been no tarry or bloody character noted. During the past year he had lost twelve pounds in weight. Two packages of cigarettes a day and a substantial alcoholic intake had been the custom for some years. There were no other symptoms.

* Presented before the Section on Surgery of the New York Academy of Medicine, April 10, 1942.

Physical examination revealed a well developed, but very thin and malnourished white male. There were a few palpable but normal nodes in the anterior cervical chain but no lymphadenopathy. The abdomen was distended above the umbilicus and tympanitic. There was tenderness in the epigastrium, and a mass thought to be the stomach was felt in the region. The liver was not palpable, nor was the spleen.

X-ray films were taken the following day. The pertinent findings are as follows:

"There is a marked hypertrophy of the rugae throughout the entire stomach. The lesser curvature of the stomach appears pliable throughout although peristalsis is extremely irregular. On palpation there is an apparent mass which is moderately tender along the greater curvature of the stomach in the mid portion of the fundus. The greater curvature at this point appears somewhat indurated with no peristaltic waves passing along the greater curvature. There is a fairly large niche along the greater curvature in this region."

The patient was admitted on January 24th to St. Clare's Hospital and the stomach washed out twice the following day. On admission his temperature was 99.6°F., pulse and respiration normal, white blood count 13,400, 81 per cent polymorphonuclears, 80 per cent hemoglobin, 4,280,000 red blood cells. The patient was operated upon January 28th, the stomach being washed one hour before operation.

Operative findings were as follows: Exploratory laparotomy was performed under cyclopropane anesthesia. The stomach presented directly into the wound, and a perforation of an ulcerated area was seen to be present on the posterior wall of the stomach involving the greater curvature into the gastrocolic omentum. This perforation was apparently very recent. The position of this ulcerated area was in the middle third of the stomach, being near to the tail of the pancreas. When palpated an area the size of a silver dollar was found to be paper-tissue thin and another area twice this size to be necrotic. The perigastric nodes were enlarged and firm but not stony hard. The liver and spleen and retroperitoneal nodes were apparently normal. A gastric resection was performed removing the lower two-thirds of the stomach and the first portion of the duodenum down to the pancreas with anterior gastroenterostomy.

Pathological Report. "Specimen was composed of a resected stomach including cardia end and most of the fundus and first segment of duodenum. The wall measures 3 mm. The mucosa is hypertrophied. The rugae are markedly prominent. There is an oval excavation area which measures 2½ by 1½ by 1 cm. The edges are round. The base is rather smooth. The mucosa surrounding this area is thickened and hypertrophied. There is a perforation extending through the entire wall. This measures 1 cm. in length, and extend through the serosa. The opening appears recent. There are enlarged lymph nodes around the gastrocolic portion.

"Microscopic—There is necrosis of the mucosa with diffuse infiltration of the mucosa, submucosa and muscularis with numerous lymphocytes and round cells. There is an increased amount of granulation tissue at the base of the necrotic mucosa. The lymph glands show evidence of an increased amount of lymphocytes within the medullary sheath and sinuses."

Several pathologists agreed that this was a case of lymphosarcoma arising from lymphocyte cells of the stomach and with metastasis in perigastric nodes.

The patient made an uneventful recovery, was given fluids in small amounts through a stomach tube six hours postoperatively. He was taking soft gruels on the third day, was on a light diet on the twelfth day, out of bed on the fourteenth, and discharged on the seventeenth.

X-rays of the chest were negative. The patient received 1,750 r. units of radiation in six treatments from March 10th to March 24th. Check-up *x*-rays taken one year later showed negative chest and gastrointestinal series.

APPENDICEAL LITHIASIS*

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IN 1915, Pfahler and Stamm[1] in a comprehensive review of the literature, were able to find only one case of appendiceal lithiasis which had been correctly diagnosed prior to operation and that by Weisflog[2] in 1906. Packard,[3] in 1921, published a paper titled "Appendiceal Lithiasis—Report of a Case, Unique in the Annals of Surgery." He carefully perused the medical journals of the previous twenty years and was unable to find a report of an appendiceal calculus approaching in size the one he described. His stone, which was not preoperatively diagnosed, measured 4 by 1 by 2 cm. Since then, there have been sporadic case reports in the American literature and for that reason, this case report and review of the American literature is in order.

CASE REPORT

The patient, M. J. S., a thirty-three year old white male, was inducted into the Army on April 5, 1942, and was admitted to the Station Hospital at Keesler Field on June 17, 1942. The family history revealed that a sister and brother were under treatment for gallstones. His past history was irrelevant. He dated his present illness to two years previous to his admission with the onset of recurrent attacks of epigastric and right lower quadrant pains which would radiate across the lower half of the abdomen having no relation to meals. These attacks would occur about twice weekly and last about one-half hour. Eight months ago, he experienced a very severe attack of right lower quadrant pain which was associated with nausea and persisted for two days. A physician was called who made a diagnosis of gallstone colic and administered a hypodermic injection with relief. Since then, he had had recurrent mild attacks associated with nausea. His appetite had been poor and he believed that he had lost about twenty pounds in weight during the past year. He had always been subject to constipation.

On admission, the patient was found to be undernourished, not ill appearing and in no apparent distress. Physical examination failed to reveal any abnormal findings except for slight tenderness in the right lower quadrant with no definite palpable masses. His temperature, pulse and respirations were normal. The white blood count showed 6,350 cells with the following differential: polymorphonuclears, 64 per cent; lymphocytes, 32 per cent, monocytes, 2 per cent and eosinophiles, 2 per cent. Urinalysis was negative. A gastric analysis (fractional alcoholic test meal) revealed that the peak of the acid curve was reached in forty-five minutes with 47 degrees free hydrochloric acid and 58 degrees total acidity.

An *x*-ray study of the gastrointestinal tract was then done. This revealed the stomach and duodenum to be normal. On the preliminary scout film as well as on the flat plate of the abdomen with the stomach filled with barium (Fig. 1) there was noted a round, laminated, opaque shadow measuring about 2 cm. in diameter in the right lower quadrant. At this point, it was believed that this most likely was a gallstone in the terminal ileum. However, at the six-hour observation (Fig. 2) it was seen that the calculus was definitely not in the ileum and it appeared as if the appendix, which was filled with barium in its proximal portion, extended into the stone. On fluoroscopy, the cecum, appendix and calculus were seen to be freely movable. It was then believed that the shadow represented an appendiceal calculus. To further corroborate this impression, a gallbladder series was done which showed a normally functioning organ with no evidence of any calculi present.

On July 20, 1942, under spinal anesthesia (Capt. C. E. Fierst, anesthetist), a right lower rectus incision was made (A. M. T.) and the cecum and appendix mobilized. There were no adhesions and the appendix showed no inflammatory changes but presented a dilatation in its proximal half caused by a firm oval mass within

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its lumen. The distal half was normal and free. Appendectomy was carried out in routine fashion. The patient's postoperative course was uneventful and he was discharged from the hospital on the twelfth postoperative day.

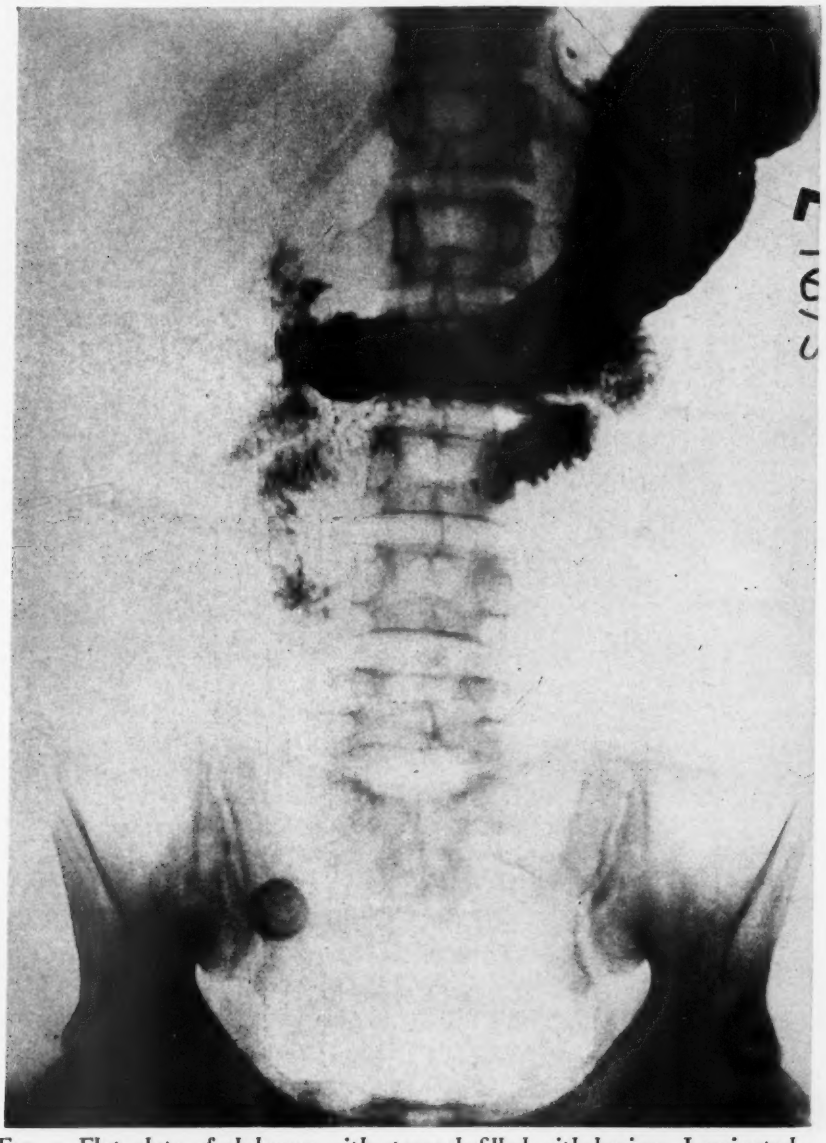

Fig. 1. Flat plate of abdomen with stomach filled with barium. Laminated, opaque calculus noted in right lower quadrant.

The pathologic report revealed the following: The appendix measured 5 cm. in length and 2½ cm. in diameter across the upper half. (Fig. 3.) On opening the organ (Fig. 4), a stony hard, irregular, round mass, 2½ cm. in diameter, dark brown in color with mottled darker and lighter areas was noted in the proximal half. On section, this stone had a shiny granular, light yellowish-brown central portion and a laminated, more coarsely constructed peripheral portion. Microscopic examination of the appendix through its proximal half failed to reveal any signs of an acute inflammatory process. The thickness of the wall here measured 4 mm. There were noted scattered lymphoid aggregates with the mucosa infiltrated by large numbers of eosinophiles with fairly numerous plasma cells and occasional pigment-containing macrophages. A marked increase in fibrosis of the muscular wall was evident. A section through the tip of the appendix showed an atrophic mucosal epithelium with the mucosa infiltrated by numerous eosinophiles. The submucosa was converted into an irregular dense fibrous zone with

intervening areas of fatty tissue and the muscularis showed a marked increase in fibrous tissue. No analysis of the calculus was done.

Fig. 2. Spot film of ileocecal region at six-hour observation. The appendix is seen extending out to the calculus.

REMARKS

A definite distinction must first be drawn between what constitutes an appendiceal calculus in contradistinction to a fecalith. The latter are non-opaque concretions which are revealed as rounded, clear translucent areas in the barium filled appendix. They are usually multiple, small in size and rarely if ever larger than the caliber of the lumen. Statistics indicate an incidence of from 5 to 80 per cent, depending upon the type of disturbance found (Feldman[4]). On the other hand, appendiceal calculi are opaque concretions and are rarely found in the appendix. Bunch and Adcock[5] found only one such case in a series of over 2,000 cases studied. They are usually single, generally circular and although they may be solid stones, they may be laminated. They are also commonly larger than the normal appendix lumen.

Normally, the fecal particles which enter the appendix are returned to the cecum by means of peristaltic contractions of the walls of the appendix. If, however, the return of the mass is impeded in any way, the fluid is gradually absorbed and the mass becomes more or less inspissated. Due to the irritation of the mass and the associated bacterial activity, a low grade inflammatory process ensues resulting in increased secretion of mucus into the lumen from which, because of chronic stasis, inorganic salts are deposited on the surface of the dried fecal particle. This causes an increase in size of the calculus which as it enlarges, because of its obstruction, causes additional inflammation with more active secretion of mucus. Hence, the reason for the laminated appearance of many of these stones.

As to the composition of these concretions, Maver and Wells[6] examined three collections of concretions found in human appendices removed at operation and found that about one-fourth of the total weight was composed of inorganic material, chiefly calcium phosphate. About one-fifth was organic residue, mostly vegetable fiber and about one-half their weight soluble was fat solvents, chiefly soaps, koprosterol and cholesterol. The stones found by Vermooten,[7] Levi,[8] Wells[9] and Bunch and Adcock were found to be composed largely of calcium phosphate.

FIG. 3. Appearance of the appendix after its removal. Tip of appendix held by forceps, with proximal portion dilated.

FIG. 4. Appendix after it had been opened to reveal the irregular, stony hard calculus in the proximal portion which was the cause of the dilatation.

Diagnosis. A perusal of the case reports in the literature reveals that there are no characteristic symptoms which might be of diagnostic importance. Seven of the ten complete case reports reviewed gave a history of three months to two years' duration of recurrent cramp-like abdominal pains. One case presented symptoms for one week and at operation an appendiceal abscess was found. One case gave a history of two days' duration and an acutely distended organ was found whereas in the last case, there were no symptoms. The only certain method of diagnosing this finding is by *x*-ray examination. A flat plate of the abdomen will reveal the stone in the abdomen, the location of which will depend upon the position of the appendix. The variable position of the organ plus the occasional location of the stone in the tip of the appendix makes for the errors in diagnosis noted in previous cases, some having been preoperatively diagnosed as ureteral stones[10] and others, because of their laminated appearance, as gallstones.[11,14] However, a barium study of the intestinal tract should reveal the location of the stone in relation to the appendix. A lateral film of the abdomen may aid in differentiating it from a ureteral stone and occasionally, urographic studies may be indicated in order to arrive at the correct diagnosis. The fact that inadequate *x*-ray studies were made accounts for the fact that only two[12,13] of the ten cases were correctly diagnosed. Both of these were found by means of a flat plate of the abdomen. Albert's case[14] had had a barium study of the stomach and duodenum but no six or twenty-four hour observations were made.

SUMMARY

It is believed that the diagnosis of appendiceal lithiasis must be entertained in every case of calcification found by *x*-ray in the right lower quadrant. Lateral *x*-ray of the abdomen and barium studies of the intestinal tract are useful diagnostic measures to be utilized in an attempt to arrive at the correct diagnosis. Once the diagnosis is made, surgery is definitely indicated as five of the cases reviewed showed an acutely inflamed organ at operation and one of these had ruptured with a localized abscess formation.

CONCLUSIONS

1. A case is reported of an appendiceal calculus which was preoperatively diagnosed.

2. A review of the American literature impresses one with the rarity of this finding.

3. The diagnosis of appendiceal calculus is discussed.

4. When definitely diagnosed, surgery is indicated as a superimposed acute inflammatory process with perforation may occur as a complication.

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MULTIPLE PRIMARY MALIGNANT LESIONS

TWO CASE REPORTS

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THE incidence of multiple malignant lesions is much higher than estimated by the average clinician who has had no special training in pathology. Kirshbaum and Shively[1] who have reported the largest autopsy series, found multiple malignant lesions in twenty-five, or in 1.77 per cent. The highest incidence of multiple malignant lesions has been reported by Burke[2] who found multiple malignant lesions in forty-six cases out of 583. This is an incidence of 7.8 per cent. Hurt and Broders[3] found seventy-one cases of multiple malignant tumors in 2,124 cases of malignancy, an incidence of 3.3 per cent.

The two cases reported here are not published because we think of them as rarities, but rather because we believe that many similar cases will be found if clinicians are made aware of their frequent occurrence. It is perfectly natural for the examiner to be satisfied with the diagnosis of carcinoma with metastases, and from then on all clinical signs are explained by the primary diagnosis. However, if the examiner is thorough and keeps on investigating he will find that in a fair number of cases he will discover an additional lesion, quite possibly a malignant one, which he did not expect to find originally.

In our first case the diagnosis, carcinoma of stomach with metastases, was made early. Later when symptoms developed which did not fit the diagnosis, further examination disclosed the presence of a prostatic carcinoma which also had metastasized.

In the second case, prostatic carcinoma with metastases, was the primary diagnosis, but when rectal spasm became an outstanding complaint, further examination disclosed the presence of a rectal tumor which did not arise from the prostate.

CASE REPORTS

CASE 1. The first case is that of an adult, white male, sixty-four years of age, who was admitted to the hospital on January 12, 1941. His complaints were pain in the right thigh and leg, pain over the chest and back, cough, weakness, some fever for the past six months, and epigastric pain following meals. The pain in the leg could be relieved only by opiates.

His past history was not significant. He had a hemorrhoidectomy in 1912. In his family history he stated that his father died of carcinoma of the stomach at the age of sixty-four, and one brother died of carcinoma of the stomach at the age of fifty-six.

He was a sixty-four year old white male, intelligent and well oriented. He appeared chronically ill. He had a good physique, but it was apparent that he had lost considerable weight. There was marked pallor of the skin, mucous membranes, and nail beds. The skin had a lemon-yellow tint with diminished turgor due to loss of subcutaneous fat. His head, eyes, ears, nose, and throat were normal. His thyroid appeared normal. There was no evidence of organic heart disease. Blood pressure was 130/70. A few sibilant râles were heard over the lung bases. Ribs appeared and felt normal, but marked tenderness was present over his sternum. His abdomen was entirely negative; no masses were felt. The liver and spleen were not enlarged. On rectal examination there was a moderate enlargement of both lateral lobes of the prostate. In the left lobe, at its upper margin, a hard nodule was palpable. There was tenderness over his right thigh and leg; there was no edema of the lower extremities.

Just after admission, the patient had a severe hematemesis, and for a long time thereafter had occult blood in his stools. Gastric analysis revealed a complete absence of free

hydrochloric acid. Although no filling defect of the stomach was demonstrable on *x*-ray, a definite hourglass constriction was seen.

The patient slowly lost ground and died on May 15, 1941.

A complete autopsy was performed. The

Fig. 1.

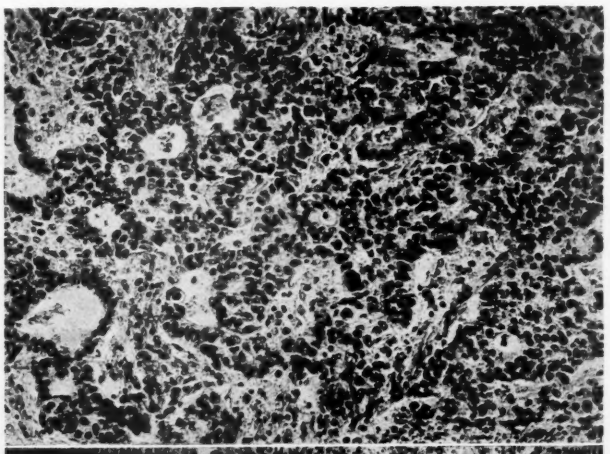

Fig. 2.

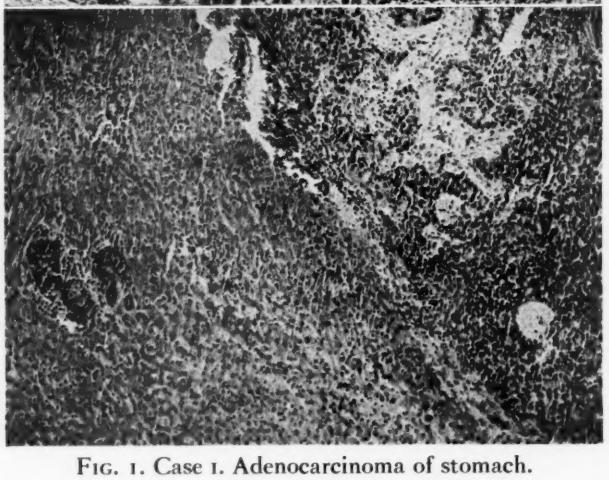

Fig. 1. Case 1. Adenocarcinoma of stomach.
Fig. 2. Case 1. Metastatic tumor in liver.

Numerous blood counts showed a very severe anemia, the red cells being approximately a million with numerous hemoglobin readings that varied between 24 and 28 per cent. The hematemesis, occult blood in the stool, *x*-ray findings of hourglass constriction of the stomach, and the severe anemia, plus the achlorhydria, made a definite picture of carcinoma of the stomach.

Examination of his bony structures by the roentgen ray revealed metastatic lesions of the skull, ribs, spine, pelvis, and femora. Because of the rarity of metastasis to these bones from a primary carcinoma of the stomach, it was believed that the nodule in the prostate was also a primary malignancy.

A sternal bone marrow biopsy revealed that the normal architecture of this bone was completely replaced by metastatic malignant cells. findings were: adenocarcinoma of the stomach with gastrointestinal hemorrhage and with a metastatic nodule in the liver; adenocarcinoma of the prostate with metastases to the sternum, pelvis, femora, and ribs.

Histological studies showed one carcinoma of gastric origin with hepatic metastasis, and another prostatic in origin with bone marrow metastasis. The former was characterized by the occurrence of acini lined by columnar type of epithelium, large vesicular nuclei containing prominent nucleoli. Its origin could be traced from gastric mucosa in several places which showed a marked degree of anaplastic changes.

The prostatic carcinoma was of the medullary type, and was composed of large groups of polyhedral cells with vesicular and densely pyknotic nuclei. There were attempts of acinar formation.

The bone metastases showed morphological characteristics similar to the neoplasm as seen in the prostate. (Figs. 1, 2, 3 and 4.)

spine did not show any metastases. An intravenous pyelogram showed normal kidneys and ureters. The blood chemistry findings were

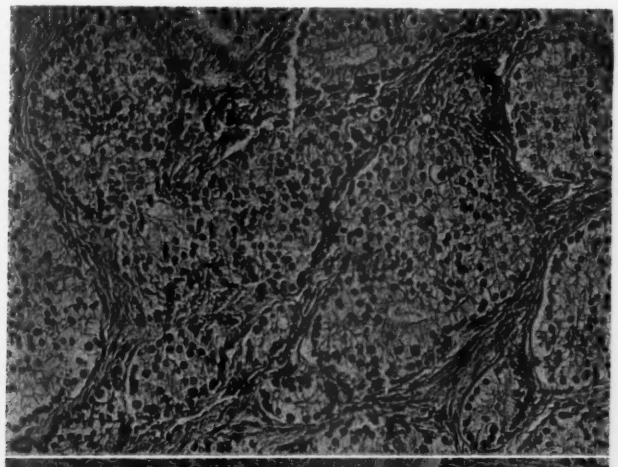

FIG. 3.

FIG. 4.

FIG. 3. Case 1. Adenocarcinoma of prostate.
FIG. 4. Case 1. Metastatic tumor of sternum.

CASE II. The second case is that of a sixty-two year old male who was admitted for the first time in April, 1941. The one significant fact in his past history was an incomplete suprapubic prostatectomy in 1937, at another hospital, which resulted in a vesicorectal fistula. This persisted for six months. At the time of his admission he suffered from urinary frequency and dysuria. The residual urine measured 650 cc. Cystoscopy showed an irregular bladder neck, an inelastic prostatic urethra, and nobbins of white tumor tissue growing into the lumen of the urethra and beneath the mucosa of the bladder neck. The rectal examination revealed a large flat, fixed mass of wooden hardness which extended beyond the reach of the examining finger. A roentgen plate of the pelvis and the lumbar normal. Diagnosis: carcinoma of the prostate. A suprapubic cystostomy was made, at which time the tumor tissue at the neck of the bladder could be seen and felt. The patient did poorly. Two months later he developed pain in the left leg which was temporarily relieved by two intradural injections of alcohol.

In October he had become bedridden. He had continuous pain in both legs, both shoulders and in the neck. A roentgen plate of the pelvis showed a large dense lesion involving the entire right ala of the ilium. There were also lesions of the sacrum, of the left ilium, of the right pubic, and of the right ischial bone. The fifth lumbar vertebra showed an increased density. The plate of the cervical spine showed osteolytic and osteoplastic lesions of the fourth, fifth, and sixth cervical vertebrae, most marked

in the fifth. The rectal examination showed again the large, fixed, mass of wooden hardness in the region of the prostate. On October 20th a bilateral orchidectomy was done which resulted in a startling improvement of the patient's condition. Five days after the operation he was able to walk, he could move his head freely, and he had hardly any pain.

However, six weeks after the operation he developed severe spasms of the rectum with bloody stools. A rectal examination at this time showed a diminution of the prostatic mass, which, however, was still very hard and fixed. Above the prostate a very soft, fungating, and pedunculated tumor could be felt. On December 10th this tumor mass was removed by blunt dissection after dilating the anus. The histological diagnosis of the tissue removed was sarcoma.

The patient rapidly lost ground from then on. Necrotic tissue masses were expelled through the suprapubic opening and also per rectum. He died on January 27, 1942.

Only a limited autopsy permission could be obtained, allowing the removal of the bladder and the rectum. The bladder contained a soft, pedunculated, partly necrotic tumor which arose from the trigone. The tumor had grown through the vesicorectal fistula into the rectum where it also formed a soft, pedunculated, partly necrotic tumor mass measuring about 10 cm. in diameter. The prostate was hard, but not markedly enlarged.

The histological examination of the soft tumor showed it to consist of spindle-shaped cells containing large ovoid nuclei with large prominent nucleoli. There were numerous mitotic figures and few multinucleated tumor cells. Fine striations could be seen in the cytoplasm of some of the larger cells. Diagnosis: rhabdomyosarcoma.

Fig. 5.

Fig. 6.

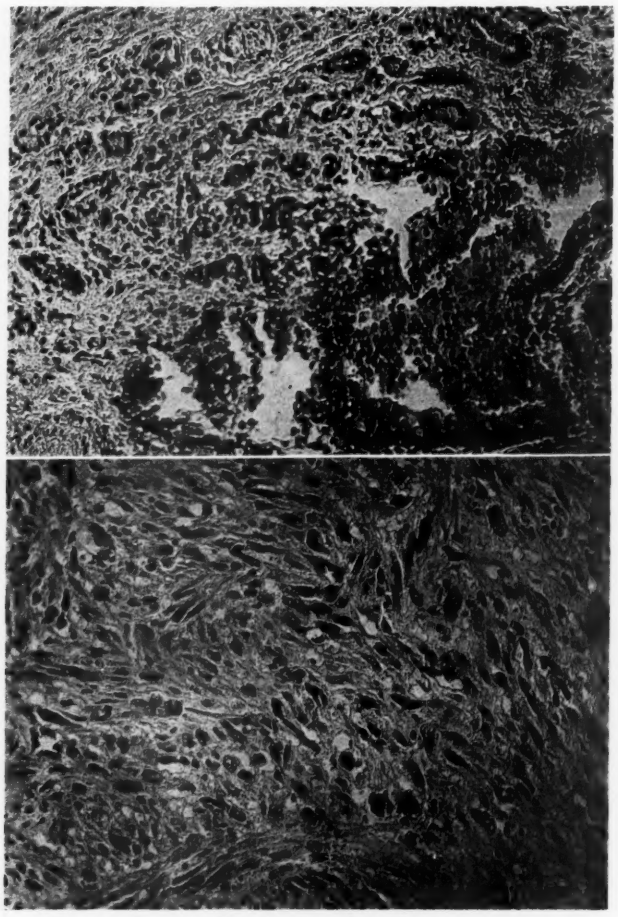

Fig. 5. Case 11. Carcinoma of prostate.
Fig. 6. Case 11. Rhabdomyosarcoma of bladder.

The sections of the prostate showed irregular proliferating acini lined by high cuboidal epithelium with rounded vesicular nuclei. Some nuclei though were densely pyknotic. In other places acanthomatous plaques of polyhedral cells with abundant cytoplasm and large prominent nuclei were found. Diagnosis: carcinoma of prostate. (Figs. 5 and 6.)

SUMMARY

1. Attention is drawn to the relative frequency of multiple malignant tumors.

2. Two cases are presented, one with two carcinomas, both of which metastasized, and one with a carcinoma and a sarcoma.

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AFTER abdominal operations of a major character, only the subcutaneous and the intravenous routes are to be depended upon for the administration of fluid. In the main, unless the rate of flow is adjusted carefully, it is better to give saline solution, or 5 per cent solutions of glucose under the skin. The too rapid intravenous administration of fluid is hazardous, especially in poor risk patients.

MANGLE BURN INJURIES

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MUCH literature in the present day medical journals has to do with the treatment of burns. I want to present here a rather infrequent type of burn, i.e., compression burn, from an iron mangle, by presenting a case in which the patient was treated with sulfathiazole ointment followed by three types of skin grafting. The functional result was good. The cosmetic results will improve with the age of the child and further plastic procedures if necessary.

FIG. 1. Photograph taken six months after burn.

CASE REPORT

On May 28, 1942, a four-year old female child was brought to the hospital approximately one-half hour after sustaining a second and third degree compression burn on the dorsum of the right hand, fingers, forehand and four inches up above elbow, in a hot mangle which the mother left running while she answered the telephone. The child was in mild shock. Morphine sulfate gr. 1/6 was administered. *X*-ray revealed no fractures. The skin of the hand not burned was scrubbed with green soap and followed by white merthiolate solution. The hand was then wrapped in dressings saturated with 5 per cent sulfathiazole ointment. In three weeks a good clean granulating surface was present.

On June 19th, under general anesthesia, the hand, including the knuckles and wrist joint, was placed in a double slit pocket in the skin of the abdomen for a full thickness graft. A few nylon 4° interrupted stitches were used to hold the graft closely to the hand. Thiersch grafts were placed on the dorsum of fingers, and multiple pinch grafts were used above the

* Dr. Lyle is now on active duty as a Captain in the Medical Corps.

wrist. These grafts were held in place by paraffin mesh gauze; then a torso cast was applied to hold the arm in position for graft healing.

The patient developed a temperature of 102° and 103°F. on the third day, postoperatively. Sulfathiazole by mouth was given. The fever remained around 101°F. until a window in the cast over the hand was removed and the abdomen under the graft irrigated with half strength hydrogen peroxide containing 1 Gm. of sulfathiazole powder. The temperature elevation was due to inadequate drainage beneath the palm.

Two weeks after the original operation the full thickness graft was cut free. This graft was well fixed to the dorsum of hand and wrist. The Thiersch grafts had taken well on fingers, and most of the pinch grafts. Two weeks later pinch grafts were put on the granulating surface on the abdomen. After curetting the granulation remaining on the forearm, additional pinch grafts were placed on the forearm.

On August 21st, the patient was discharged with a very good functional result. I believe with care of this new skin by a mild cod liver ointment, cosmetic results will be good by the time she is a young lady, without additional plastics which could be done. One *x*-ray therapy treatment was used to prevent keloid formation.

A BETTER knowledge of the effects of obstruction; a more acute appreciation of the criteria which permit timely recognition of the presence and identification of the type of obstruction; and, finally, a more discerning understanding of the limitations and virtues of the available remedial agents, together with a keener interest in the technique of carrying out therapeutic precepts with precision—these are the important items in the bowel obstruction problem.

The brief excerpts in this issue have been taken from "Intestinal Obstructions" by Owen H. Wangensteen, Second Edition (Charles C. Thomas).

PNEUMOCOCCIC MENINGITIS AND ENDOCARDITIS FOLLOWING FRACTURE OF THE SKULL*

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ACUTE pneumococcic endocarditis is conceded to be a rare and fatal complication of pneumococcemia. However, its rarity may be dispelled if an attempt is made to establish the diagnosis. According to Ruegsegger[1] the diagnosis should be made in 50 per cent of the cases provided suitable laboratory facilities are available. The following case is reported because of its unusual clinical course and necropsy findings:

CASE REPORTS

B. V. S., a forty-five year old white male, was admitted to Morrisania City Hospital on October 9, 1941, after having been picked up in the street. He had no recollection of what had happened in the twelve hours preceding admission except that he had been "drinking." His family history was noncontributory. It was noted in his past history that the patient had been confined to bed for many weeks because of rheumatic fever at twenty-three years of age. "Drinking bouts" had increased in frequency during the past few years. For the past year he had suffered from repeated attacks of "neuritis." In the few days prior to the present episode he had a "head cold."

On admission to the hospital he presented the picture of a well developed, well nourished white male, acutely ill with a distinct alcoholic odor to his breath. There was a laceration over his left eye. Both pupils were equal in size, regular, and reacted to light and accommodation. Old and fresh blood oozed from both nares. Both lungs were clear to palpation, percussion and auscultation. The heart was enlarged to the left. The point of maximum impulse was in the sixth intercostal space outside the midclavicular line. There was a harsh systolic murmur at the apex transmitted to the axillary region. A low pitched diastolic blow was also heard over the apex. Over the aortic area a systolic murmur associated with a systolic thrill was elicited. Examination of the abdomen and extremities revealed no positive findings. Neurological examination revealed no impairment of the cranial nerves. Abdominal reflexes were present on the right and absent on the left. Biceps, pectoral, knee jerks, ankle jerks were active, particularly on the left. Kernig and Brudzinski signs were negative. Babinski was negative on the right, suggestive on the left. There was no nuchal rigidity. Sensation and muscular power were good. Admission temperature was 101°F., pulse 96, respirations 22. Laboratory findings were: Hemoglobin 85 per cent; red blood cells 4,100,000; white blood cells 21,000 with 78 per cent polymorphonuclears, 14 per cent transitionals and 8 per cent lymphocytes. Urinalysis was negative. The impression on admission was: (1) Craniocerebral trauma—concussion and possible fracture of the skull; (2) rheumatic heart disease (inactive); (3) acute alcoholism.

During the first hospital day the temperature rose to 102°F. and on the second day to 104.8°F. At this time the patient developed a productive cough and the sputum was streaked with blood. Examination of the sputum revealed pneumococcus type VII. Diminished breath sounds were heard over the left chest posteriorly. *X*-ray of the chest was negative. The blood count showed white blood cells 23,000 with 82 per cent polymorphonuclears. The urine was negative. He was placed on sulfapyridine therapy on the second day, receiving 90 gr. per day. Temperature dropped on the third day to 101.4°F. and on the fourth day after touching 102°F. at twelve o'clock noon, it dropped to normal.

On the third day he had developed signs of meningeal irritation, viz., stiff neck, bilateral Kernig's, weakness of his right upper extremity with a suggestive wrist drop. He was confused, disoriented and very restless. The impression at this time was probable subarachnoid hemorrhage and a right brachial plexus lesion. Spinal

* From the Service of Dr. Thomas I. Brennan, Morrisania City Hospital, New York.

tap done at this time revealed a faintly xanthrochromic fluid with an initial pressure of 130 mm., 1,200 red blood cells, and only an occasional white blood cell was present. Sugar was negative and Pandy was positive. Smear revealed many Gram-positive diplococci which were identified as pneumococci type VII with Neufeld typing. Culture of the same fluid twenty-four hours later was also positive for the same organisms. The presence of a pneumococcic meningitis was now confirmed, probably secondary to a basilar fracture of the skull and pneumonia, despite absence of *x*-ray evidence (which was deferred, owing to the critical condition of the patient). A blood culture taken at this time showed contamination and was discounted.

FIG. 1. Pneumococcic meningitis; plastic exudate covering cerebral hemisphere.

On the fourth day the patient still seemed drowsy but his restlessness had diminished. On the fifth day spinal tap revealed 150 cells (mostly red blood cells) with some white blood cells, and pneumococci were present on direct smear. Sugar was negative, total protein 236 mg. per cent. Blood sulfapyridine at this time was 9.1 mg. per cent. His temperature fell to 99°F., highest level this day was 100.6°F. He appeared clinically improved, but that night he became irrational and extremely noisy. He was given large doses of phenobarbital. The weakness of his right upper extremity seemed to be extending to his right lower extremity.

On the sixth day his temperature rose to 104°F. from the previous level of 100.6°F. On this day his spinal fluid showed 270 red blood cells and some white blood cells. There was dullness at the right base with moist râles. His condition became very poor and he gradually sank into a deep coma and died on the morning of the eighth day. The final clinical impression was: (1) Possible fracture of the skull; (2) pneumococcic type VII meningitis; (3) pneumococcic pneumonia type VII.

The essential findings post-mortem were as follows:*

Brain. Small area of hemorrhage in the left occipital region of galea. The brain weighed 1400 Gr. The vessels were markedly congested; there were many areas of greenish-yellow accumulations 2 to 3.5 cm. in diameter within the subarachnoid space clearly evident over the entire cortex of the brain, particularly over the left cerebral hemisphere. A plastic exudate covered the base of the brain, more especially the ventral surface of the pons, medulla and cerebral peduncles. There was some flattening of the convolutions on the left side. Punctate hemorrhages were noted throughout the brain ranging from pin-point to one-eighth inch in diameter. There was a branching linear fracture beginning in the left frontal bone and running downward traversing the left anterior fossa. A small amount of epidural hemorrhage was evident at the fracture site.

Heart. The pericardial sac contained 25 cc. of straw colored fluid. The right auricle and ventricle were normal. The right A-V orifice admitted two and one-half fingers. The A-V and pulmonic cusps were thin, smooth and glistening. There was no atherosclerosis of the pulmonary artery. The left auricle was slightly dilated. The left ventricle was moderately

* From Pathological Laboratory, Dr. William Aronson, pathologist. Autopsy courtesy of Medical Examiner's Office, New York City.

hypertrophied. The mitral orifice was stenosed admitting only one finger. The mitral cusps were thickened, with marked fusion of the commissures, and shortening of the chordae tendinae. The aortic cusps were thickened and contained a large amount of calcific deposits. In the region of these deposits there were ulcerations to which were attached polypoid friable vegetations. These vegetations involved the right anterior and posterior cusps. There was a thrombus of friable material in the right posterior Sinus of Valsalva. The coronary ostiae were patent. The coronaries were moderately sclerosed. The myocardium on cut section presented small areas of greyish white tissue which had all the appearance of necrosis. There was moderate atherosclerosis of the aorta.

FIG. 2. Pneumococcic endocarditis with friable vegetations involving the aortic cusps and adjacent muscle.

Lungs. Both pleural cavities contained no free fluid. The pleurae were thin, smooth and glistening. Both lungs were crepitant throughout and on cut section presented a normal architecture. Except for some congestion at the left base, there was no hilus adenopathy. The mucous membrane lining trachea and bronchi was slightly congested.

Microscopic. Right posterior aortic cusp and adjacent muscle: the cusp was markedly thickened and fibrosed. The connective tissue showed a great deal of hyaline degenerative change. On the aortic aspect there were numerous bluish areas of calcific deposits. The cusp was diffusely infiltrated with a superabundance of polymorphonuclear, lymphocytic and plasma cells. Small irregular bluish staining areas comprising bacterial clumps were also evident and under the oil immersion lens Gram-positive diplococci could be seen. The cardiac musculature immediately adjacent to the cusp showed separation and fragmentation of the muscle fibers, their nuclei in various phases of degeneration. The interstitium between the fibers was infiltrated to a marked degree with polymorphonuclear and lymphocytic cells.

Brain. The subarachnoid space was distended and filled with a great many polymorphonuclear lymphocytic cells, and with an occasional macrophage. Bacterial clumps were also evident. Vessels were distended and congested. The cells of the cortex showed evidence of rarefaction, falling out of ganglion cells with neuronophagia and generalized degenerative changes of the ganglion cells throughout the cerebrum and cerebellum.

Anatomical Diagnosis: (1) Fracture of the skull; (2) pneumococcic meningitis Type VII; (3) pneumococcic endocarditis superimposed on an old rheumatic heart valvulitis.

REMARKS

With the advent of chemotherapy meningitis is not considered as hopeless as it was formerly. In a survey of the literature one is noticeably confronted with the increasing frequency of reports of cures in meningitis, more especially since the introduction of sulfapyridine by Whitby[2] in 1938. Goldstein and Goldstein,[3] in a review of the literature, cite recoveries from pneumo-

coccic meningitis as well as recoveries even from nonpurulent meningitis reported in the past ten to fifteen years. They urge a more energetic and enthusiastic approach to these cases which in the past were considered in such an unfortunate light.

In the case reported the meningitis appeared at one time during the course of illness to be responding to sulfapyridine therapy. This is evidenced by the marked drop in temperature, the clinical improvement, and the diminution of cellular elements in the spinal fluid. The postmortem findings of an acute vegetative pneumococcic endocarditis superimposed on a previously injured valve readily explain, however, the patient's demise. This is in support of the observations that have been reported as to the relative amenability of meningitis to chemotherapy contrasted with the marked resistance of a bacterial implantation on the cusps of heart valves. Terry and Beard,[4] of the Cleveland City Hospital, reported a case of pneumococcic meningitis and endocarditis, proved clinically by positive signs and positive laboratory findings both in spinal fluid and blood, treated with sulfapyridine. In spite of the complete clearing of the spinal fluid the patient expired. At postmortem the meninges showed no pathological changes except for a slight increase in the collagenous tissue. The cusps of the aortic and mitral valves, however, showed fresh vegetative endocarditis. Thornton Scott[5] reported a case in which definite evidence of meningitis was present during life with numerous type II pneumococci on direct smears and culture of the spinal fluid. Yet, following massive doses of sulfapyridine, there was no evidence of active meningitis postmortem. The cause of death was an acute vegetative endocarditis.

The marked resistance of organisms implanted in the cusps of the valves to chemotherapy is borne out by the observations of Ruegsegger[1] who was able to recover viable organisms from pneumococci vegetation immersed twenty-two months in formalin. The organisms are embedded in such a dense protective meshwork of fibrin, platelets and cells that they become relatively immune to destruction.

In the case reported in addition to the presence of endocarditis, microscopic examination of the myocardium revealed definite evidence of a suppurative process. The existence of such a lesion is indicative of a fulminating course which would prove fatal. Involvement of the myocardium has been reported in association with endocardial lesions by Rhodes, McMahon and Burkhardt, Ginga and Bouche,[6] and in isolated form by Luphin, Westenhoppe, Glion, Balke, Klemperer.[7] The pathological lesion in the above case report is similar to those cited.

This case has been reported to substantiate many of the observations that have been made regarding the successful treatment of the purulent meningitis with chemotherapeutic drugs in contrast to the poor results obtained in cases of purulent endocarditis. In the event that the meningitis shows no signs of clearing, other foci of infection should be looked for.

SUMMARY

In this report, we have seen a fracture of the skull which was followed by pneumococcic pneumonia type VII and meningitis. Although the meningitis improved upon sulfapyridine therapy, the patient succumbed to a pneumococcic type VII endocarditis superimposed on an old rheumatic heart lesion which was demonstrated upon autopsy.

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GANGRENOUS APPENDICITIS IN FEMORAL HERNIA OF RICHTER'S TYPE*

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THE unusual occurrence of a gangrenous appendix found in a strangulated femoral hernia sac of Richter's type, which was operated upon three days after strangulation, induced the following report, and review of the pertinent literature.

CASE REPORT

Mrs. P. M., a forty-eight year old woman, was admitted September 8, 1942, with a history of severe pain in the right groin, of three days' duration. She had noted a "lump" in the right groin for about ten years, but it had disappeared three years later with her first and only pregnancy. During the past week the mass reappeared and became larger. Three days previous to operation she noted a sudden increase in the size of the tumor, associated with severe urinary urgency and frequency. She had been nauseated for about ten hours but vomited only once in a deliberate effort to relieve her distress.

Physical examination revealed essentially normal findings in all organs except for a reddened and painful tumor, the size of an egg, in the right inguinal region. The temperature was 102.4°F. with a pulse rate of 110 and a blood pressure of 106/82. A diagnosis of strangulated femoral hernia was made.

At operation under spinal anesthesia the hernial sac was located medially to the femoral vessels. The sac was filled with a foul purulent fluid and contained a ruptured and gangrenous appendix together with gangrenous portions of the omentum and part of the cecum. The appendix was removed, the gangrenous omentum was resected, and a cecostomy was done without attempt to reduce the hernial sac. The adhesions around the femoral opening were left undisturbed to prevent generalized peritonitis. About 8 Gm. of sulfanilamide were placed into the wound which was left open for free drainage.

Postoperative treatment consisted of venoclyses of 1,000 cc. of 5 per cent glucose in normal saline every eight hours for forty-eight hours, nothing by mouth, and control of abdominal distention by a Wangensteen apparatus. About seventeen days after operation the cecostomy was closed by inversion and the cecum retracted into the abdomen. The femoral wound was then closed by simple silkworm sutures. After an uneventful recovery the patient was discharged in good condition one month after admission.

REMARKS

Partial or Richter's hernia is a strangulated hernia in which only one wall of the intestines is constricted and strangulated. It is generally stated that Fabricius Hildanus observed the first case in 1598. However, his report is open to criticism because he did not see the actual anatomical relationships. His patient, a sixty-three year old woman, had a hernia of the groin for seventeen years. It became strangulated and was reduced *en masse*. Gangrene developed and led to a fecal fistula which closed spontaneously two months later. Hildanus never saw the bowel in the hernial sac, but simply believed that it formed a partial hernia because of the subsequent development of the fecal fistula.

Lavater, in 1672, was the first to describe it anatomically. A similar hernia containing the appendix was then described in 1731 by de Garengeot, who misdiagnosed it as an inguinal abscess but at operation found the gangrenous and suppurating appendix in it. In 1778, Richter published his detailed studies of partial hernias, and from then on his name has been identified with this type of partial enterocele. However, such eponyms as Lavater's hernia and wrongly also

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Littré's hernia are synonymous with it. Since Richter's hernia resembles a diverticulum, it induced Littré to describe his two cases of Meckel's diverticula as partial intestinal enteroceles. Cattell, in 1933, could find records of only fourteen Richter hernias which had come to operation between 1899 and 1933. The average age of the patients was forty-eight years.

Watson, in 1938, found a total of 537 cases of hernias containing the appendix, and 222, or 40 per cent, of these were of the femoral variety. To these should be added seven additional reports of femoral hernias containing the appendix, bringing the total to approximately 229 appendices in femoral, and to about 545 in all varieties of hernias. Not included in these figures are five cases from the foreign literature: four Italian and one Russian, reported since 1939, since the references could not be verified in the original.

Richter hernias become more frequently gangrenous than any other type of strangulated hernia, probably due to the direct pressure of the constricting ring, and because of the absence of the cushioning mesentery from the hernial sac. Symptomatically, the findings are not typical since some volume of feces and gas can still pass the partial constriction of the gut and thus generally prevent distention. Treves believed that less than 50 per cent of all femoral or inguinal strangulations show swelling or tumor formation, and that local tenderness or pain may be so slight as to pass unnoticed by the patient for several days until gangrene develops. This was also true in our patient who delayed admission for three days. Often the strangulation may suggest inguinal or femoral lymphadenitis especially when the moderate fever and pain of early gangrene sets in,—a complication which ensues rapidly and leads to an unfavorable prognosis because operative intervention is often too late. The mortality rate of Richter's hernia is, therefore, much higher than that of ordinary strangulated hernias.

Femoral hernias of Richter's type predominate in females and on the right side. According to Berger femoral hernias *per se* form 32.7 per cent of all hernias in females, but only 5.6 per cent in males.

The site of herniation is usually between the femoral vein and the lacunar ligament of Gimbernat. Hernias below the inguinal ligament of Poupart and external to the femoral vessels are rather rare. Once the hernial sac has passed through the saphenous opening into the thigh it may reflect back over the inguinal ligament and suggest an inguinal hernia. The hernial sac may contain any one, or several, of the abdominal viscera, and the sharp edges of the lacunar ligament of Gimbernat is usually the point of strangulation.

As early as 1804, Sir Astley Cooper pointed out that femoral hernias may disappear during pregnancy, not to recur until some time after parturition. This observation was also made in our patient whose hernia had disappeared seven years previously during her only pregnancy, and recurred only some time postpartum.

In Watson's monograph it is stated that 40 per cent of all femoral hernias contained the appendix, while in all other types of hernias the incidence is only 1.5 to 1.0 per cent. As far as can be ascertained only 194 of the 230 patients who presented an appendix in the femoral hernia sac were operated upon. By sex distribution 185 were women and only nine were men. Doolin's patient, cited by Seley as a man, was actually a woman. Appendectomy was performed 149 times with the death of five patients, or a 4 per cent mortality. In twenty-three instances the appendix was reduced through the hernial orifice, and two patients, or 10 per cent died. In the other twenty-two patients the gangrenous and suppurating hernial sac was merely incised and drained, and nine patients, or 40 per cent, died. These figures indicate appendectomy as the procedure of choice in the treatment of this condition, to be followed subsequently by drainage, colostomy and hernial repair as deemed necessary, since it offers the best prognosis and

has the lowest mortality as well as also the least complications.

SUMMARY

Strangulated appendix occurs simultaneously with 40 per cent of all femoral hernias. To date approximately 230 cases have been reported, including a personal observation. This condition predominates in women, since only nine males are reported. Primary appendectomy is the operation of choice. The mortality of other operative procedures is discussed. Richter's type of hernia is unusual and its contents become gangrenous more rapidly than in any other type of hernia because of the absence of the mesentery. The symptomatology is atypical and not pathognomonic.

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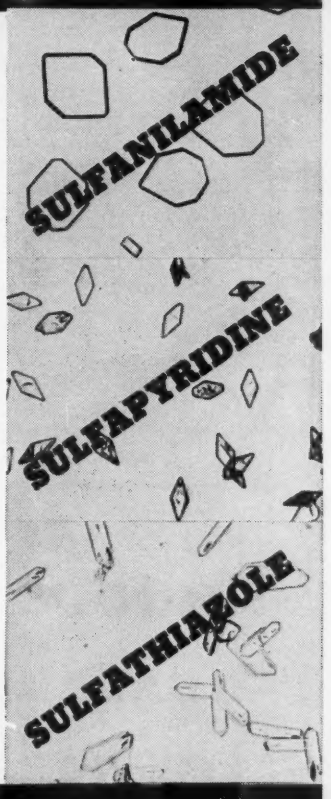

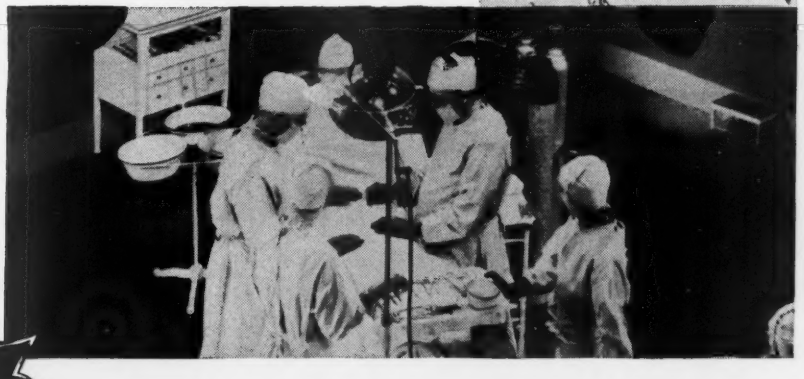

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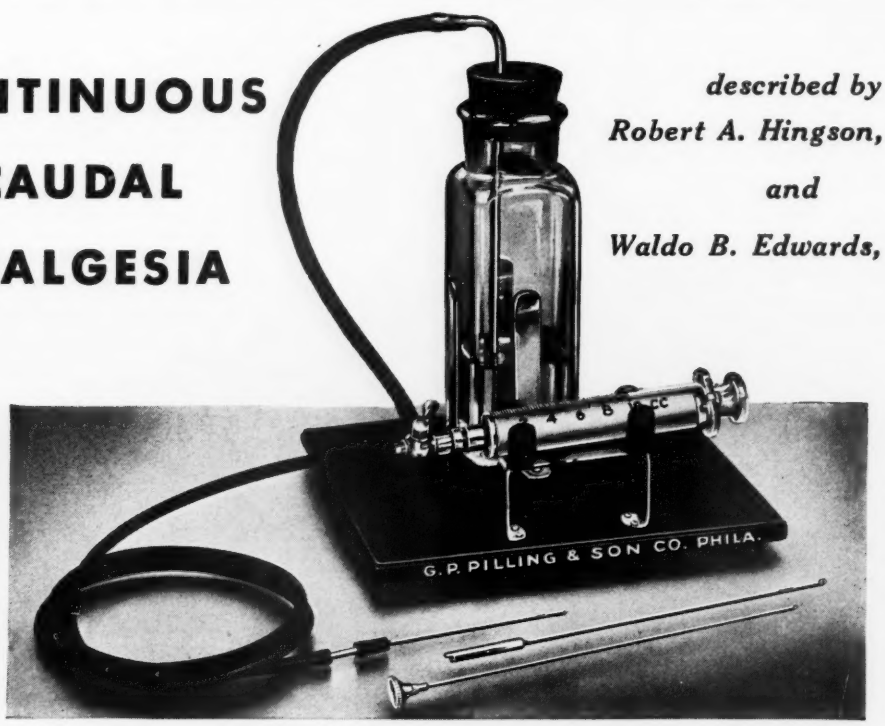

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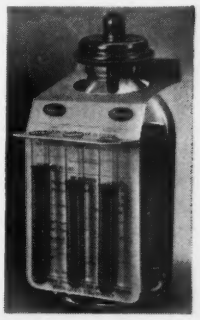

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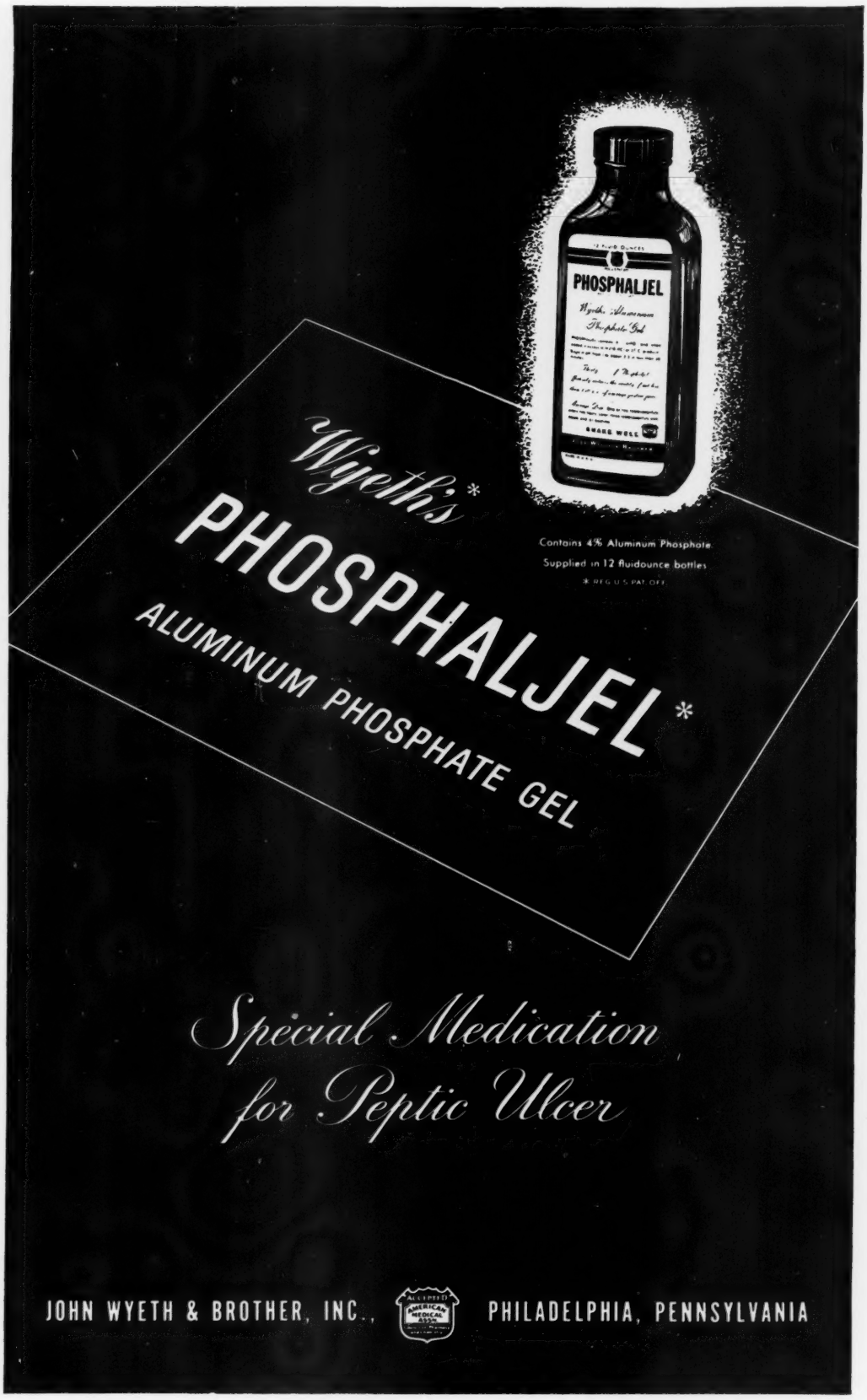
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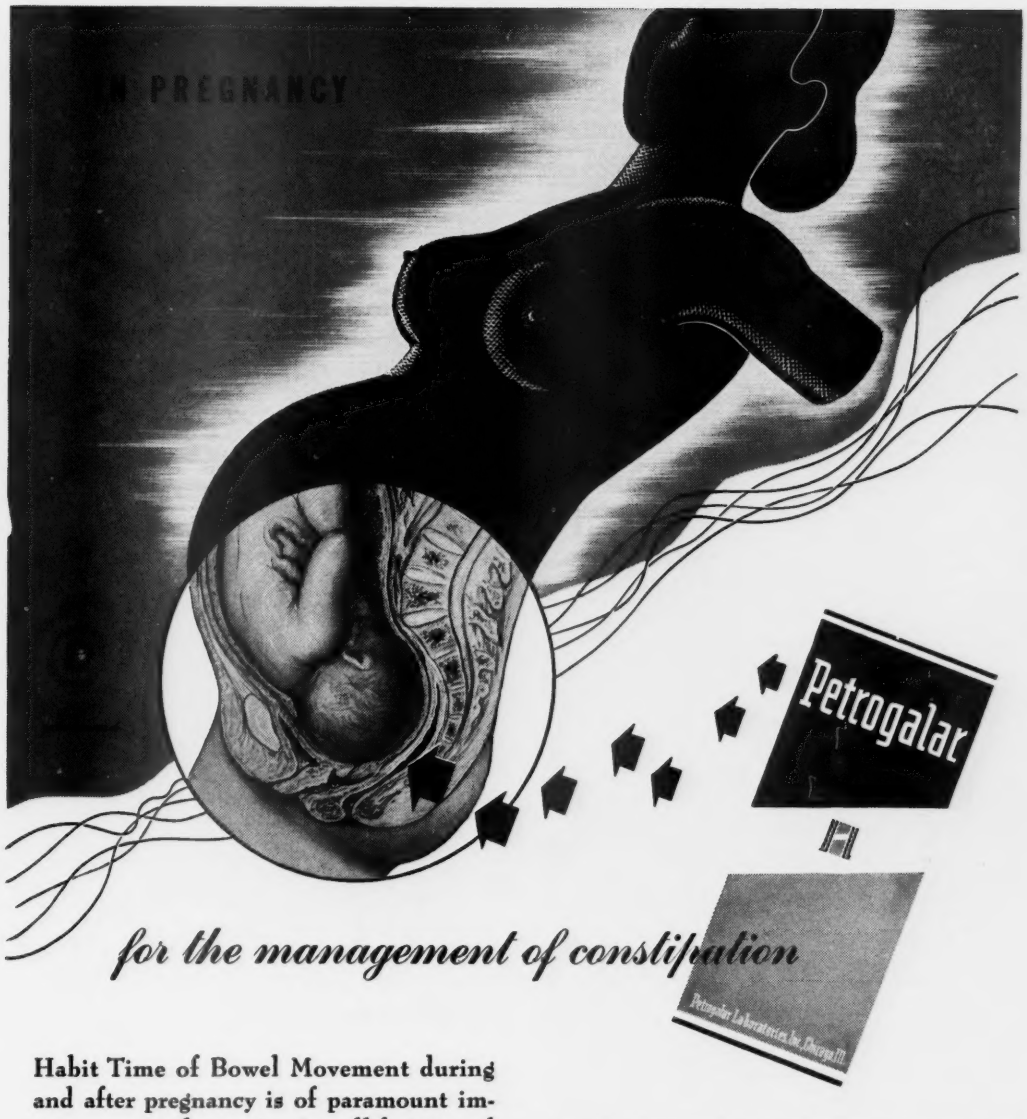

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